Antecedent and reinforcement-based approaches to decreasing feeding selectivity in children with autism

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Declaration

This work has not previously been accepted in substance for any degree and is not being concurrently submitted in candidature for any degree. This project is the work of the writer's own investigation, in collaboration with Lauren Lovegrove and Alexa Van Eenennaam for the ethics application and documents.

Signed ……Sarah Larner…….. (candidate)

Date ……5/9/16…….....

STATEMENT 1

This thesis is the result of my own investigations, except where otherwise stated. Where correction services have been used, the extent and nature of the correction is clearly marked in a footnote(s).

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STATEMENT 2

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Contents

Abstract

Food selectivity affects a high proportion of children with autism, and a range of behavioural interventions have shown success in its treatment. Escape extinction, such that escape from food is prevented, is a common component, nevertheless there are negative side-effects to this. Antecedent and reinforcement-based interventions may therefore be preferable, and following conflicting results with previous comparisons, this study initially set out to conclude whether simultaneous or sequential reinforcement is superior in increasing eating of non-preferred foods. An alternating treatments design was used for comparison with 3 children with autism, and found simultaneous reinforcement with compatible foods to be advantageous for 1 participant, however neither technique effective for 2 participants. For the successful participant, systematic fading procedures were applied using a changing criterion design to reduce the ratio of preferred to non-preferred food, and whilst experiencing time constraints, some success was made with this. For the other 2 participants, a graduated exposure hierarchy procedure was implemented in a changing criterion design. This hierarchy was found to increase participants' interactions with the non-preferred foods, nevertheless there was insufficient time to complete the hierarchy. Limitations to the study and reasons for the inconsistent results are discussed, along with suggestions for future research.

Introduction

Feeding issues are a common concern in children with autism spectrum disorder (ASD), with 46-89% indicated to display problem feeding behaviours (Ledford & Gast, 2006). These issues are varied (Marí-Bauset, Zazpe, Mari-Sanchis, Llopis-Gonzalez & Morales-Suarez-Varela, 2013), and if severe or persistent can produce developmental, health or social problems (Bachmeyer, 2009); additionally impacting the wider family (Singer, Song, Hill & Jaffe, 1990). Feeding selectivity can be defined as *'the consumption of a limited variety of food items and the rejection of most novel food items'* (Levin & Carr, 2001, p. 444), and given the broad impact on children with ASD and their families, successful treatment options for feeding selectivity are sought.

A variety of behaviour-based interventions have shown success as treatment options (Bachmeyer, 2009). This highlights the role of the environment in causing and maintaining feeding issues, with caregivers' responses to inappropriate mealtime behaviour shaping future mealtime behaviour (Bachmeyer, 2009; Piazza, Fisher et al, 2003). Negative reinforcement appears to be the main contributor, with the removal of rejected food items reinforcing the child's response (Bachmeyer, 2009). Secondary to this positive reinforcement also contributes, if following inappropriate mealtime behaviour, attention or access to preferred foods/tangibles are provided (Kerwin, 2003). These suggestions have been supported by results of functional analysis, with Piazza, Fisher et al (2003) demonstrating negative reinforcement to maintain severe feeding and behaviour problems in 90% of children tested, and positive reinforcement to impact over half.

Behavioural interventions focus around three main approaches. Firstly those relating to negative reinforcement, i.e. *escape extinction (EE),* where escape from eating is prevented (Piazza, Patel, Gulotta, Sevin & Layer, 2003), and food remains regardless of behaviour

(Piazza, 2008). The second approach includes those making use of positive reinforcement techniques such as *differential reinforcement of alternative behaviour (DRA)* where positive reinforcement is delivered for eating, alongside removal of reinforcement for disruptive behaviour (Ledford & Gast, 2006) (e.g. Riordan, Iwata, Finney, Wohl and Stanley, 1984); or the *Premack principle* where preferred food is delivered following consumption of non-preferred food (e.g. Brown, Spencer & Swift, 2002). The third approach involves antecedent manipulations, where variables are adapted before food presentation, with the aim of altering the aversiveness of the non-preferred food and therefore increasing consumption (Bachmeyer, 2009). For example *simultaneous presentation* of foods where a preferred food is presented alongside the non-preferred food (e.g. Ahearn, 2003); *stimulus fading* where the quantity of non-preferred food presented is gradually increased (e.g. Knox, Rue, Wildenger, Lamb & Luiselli, 2012), or *graduated exposure* whereby a hierarchy of successive approximations to the target food is constructed, and reinforcement provided at each stage (e.g. Tanner & Andreone, 2015).

Some researchers posit that EE is a necessary component for success given that feeding selectivity is maintained predominantly by negative reinforcement (Piazza, 2008; Piazza, Fisher et al, 2003). EE procedures include *non-removal of the spoon* where the spoon stays near the child's mouth until acceptance (e.g. Ahearn, Kerwin, Eicher, Schantz & Swearingin, 1996); *physical guidance* where gentle pressure is applied to open the child's mouth (e.g. Ahearn et al, 1996); or *representation* where expelled food is presented again until swallowed (e.g. Reed et al, 2004). Nevertheless, despite success of such interventions (Piazza, Patel et al, 2003) there are a number of negative side effects associated with EE, including extinction bursts and increased challenging behaviour, which can compromise procedural integrity if caregivers are unable to safely prompt the correct response (Bachmeyer, 2009; Tanner & Andreone, 2015). Further EE can be considered ethically

undesirable given its restrictiveness and intrusiveness, and Kerwin (1999) postulates that less restrictive interventions should be considered first. Positive reinforcement or antecedent based interventions may therefore be preferable, and Bachmeyer (2009) presents twelve studies where such interventions were successful in improving feeding selectivity without the use of EE. Necessary elements are quantity and quality of reinforcement (Cooper et al, 1999), such that there is sufficient reinforcement to guarantee its' effectiveness; and motivating operations, with deprivation created by limiting access to preferred foods before intervention meals, increasing reinforcement effectiveness (Levin & Carr, 2001).

One antecedent intervention that has had little exploration is the use of graduated exposure, whereby a hierarchy is constructed with the aim of desensitising the food (Tanner & Andreone, 2015). This hierarchy can be based on proximity (Nadon, Feldman & Gisel, 2013), and similar techniques have proved successful in changing other behaviours maintained by negative reinforcement, such as activity avoidance (Schmidt, Luiselli, Rue & Whalley, 2013). Graduated exposure may be less aversive than EE-based interventions as no food is required to be consumed to receive reinforcement, and as such the motivation to avoid or escape the demand is reduced (Tanner & Andreone, 2015). Tanner and Andreone (2015) used graduated exposure alongside differential reinforcement to decrease food selectivity successfully in a 3.5-year old boy with ASD. A 12-step hierarchy was used and following 9 months of treatment, the participant accepted over 50 different foods, compared with just four prior to intervention (Tanner & Andreone, 2015). Koegel et al (2011) also decreased food selectivity in three children with ASD using graduated exposure with a 7-step hierarchy, and positive reinforcement over 22 weeks. Promising results have further been shown as part of multi-component treatment programmes (Nock, 2002; Dovey & Martin, 2012; Suarez, 2014; Benson, Parke, Gannon & Muñoz, 2013), however evidence still remains slim, and all studies require many months of treatment to result in change.

An antecedent intervention that may prove quicker is the use of simultaneous presentation of foods to increase eating. Ahearn (2003) simultaneously presented non-preferred vegetables alongside preferred condiments to increase eating without the need for EE. This intervention increased vegetable consumption in a mildly selective child with ASD, with 100% of bites accepted during the first session showing quick results, and these results maintaining over a year showing longevity of results (Ahearn, 2003). Two suggestions explain why simultaneous presentation may be effective in increasing food consumption. Piazza et al (2002) suggest that, as outlined by Capaldi (1996), simultaneously presenting non-preferred food and preferred food should increase non-preferred food preference due to flavour-flavour learning, i.e. the non-preferred food flavour becomes associated with the preferred food flavour. Alternatively success may be due to motivating operations, with the preferred food's presence working as an abolishing operation to reduce the non-preferred food's aversiveness, consequently changing the effectiveness of escape as reinforcement (Piazza et al, 2002). Motivating operations can also be considered with sequential presentation if the preferred food is visible during non-preferred food presentation.

Several researchers have compared the success of simultaneous reinforcement with sequential presentations of foods, however with differing results (Kern & Marder, 1996; Piazza et al, 2002; Garvey, 2011; VanDalen & Penrod, 2010). Kern and Marder (1996) contrasted simultaneous presentation of foods with sequential presentation for a child with developmental disability and severe feeding refusal. Fruits were simultaneously presented, and vegetables sequentially presented during the intervention. Whilst both resulted in eating improvements, simultaneous presentation was deemed superior since it was quicker and accompanied by less self-injurious behaviour. Nevertheless differences between fruits and vegetables could be influential, and additionally EE was used making it hard to decipher the relative contributions of EE and the presentation methods. These limitations were addressed

by Piazza et al (2002) who matched food across conditions and only implemented EE if the initial presentation failed. Their multi-element design replicated Kern and Marder's results, and whilst there was variation in findings between participants, simultaneous presentation was found superior in all three participants with developmental disabilities and feeding selectivity (Piazza et al, 2002). The first participant made gains with both presentation methods, however these gains were more rapid with simultaneous presentation. Participant two only made gains with simultaneous presentation, and participant three also favoured simultaneous presentation, however only following the addition of EE (Piazza et al, 2002). These differences may however be explained by procedural inconsistencies. The first participant received the same foods for both conditions, thus interference could have occurred. The other participants used matched foods however presentation differed. Participant ones non-preferred food was hidden within the preferred food, participant two received preferred dressing on top of non-preferred food, and participant three received the non-preferred food on top of the preferred food. Although the second participant preferred dressing, dressing typically accompanies food potentially explaining why gains were made only with simultaneous presentation. Further, difference in non-preferred food visibility potentially impacted results (VanDalen & Penrod, 2010). Additionally neither Kern and Marder (1996) nor Piazza et al (2002) attempted fading the preferred food in the simultaneous conditions. Given that preferred foods typically have poor nutritional value (Bachmeyer, 2009), fading of these foods is desirable since it is nutritionally and practically beneficial.

VanDalen and Penrod (2010) set out to extend research by Kern and Marder (1996) and Piazza et al (2002), however produced conflicting results. A multi-element design compared simultaneous and sequential conditions for two children with ASD and feeding selectivity, however following no success EE was added. When combined with EE treatments

were equally effective, increasing eating to 100%, however participants chose to eat the foods in both conditions in a sequential format. Nevertheless, procedural differences could explain divergence from previous studies since initially 21 bites of food were presented. Whilst naturalistic, this could be daunting compared to one piece presented by both Kern and Marder (1996) and Piazza et al (2002). Response effort could therefore have been perceived higher despite reinforcement occurring at the same rate (every piece). Additionally this was adapted when EE was added, with number of bites reduced to 3 (VanDalen & Penrod, 2010). It is therefore unclear whether the procedure change or EE was responsible for the consumption increase. Further, the compatibility of the food combinations could have affected results, with unappealing food combinations such as hot dog and cake (VanDalen & Penrod, 2010) presented, compared with more appealing combinations including vegetables/proteins and chips (Piazza et al, 2002) or vegetables and condiments (Ahearn, 2003). Complimentary food combinations therefore may be important in ensuring success of simultaneous presentation.

An advantage of VanDalen and Penrod's experiment, however, is that the preferred food was faded to one terminal reinforcer following the meal. Systematic fading also occurred in Garvey's (2011) experiment where simultaneous and sequential reinforcement were compared alongside EE with two 16-year old males with ASD. For the first participant, simultaneous and sequential presentations both produced rapid increases in non-preferred food consumption, which was faded to 100% non-preferred food consumption in the absence of the preferred food. For the second participant, only sequential presentation plus fading was successful. Nevertheless the simultaneous condition used mashed potato which appeared particularly aversive to the participant, potentially impacting results. Both Garvey (2011) and VanDalen and Penrod (2010) therefore found contrasting results to Kern and Marder (1996) and Piazza et al (2002), suggesting that simultaneous presentation may be less effective than initially thought. Further, some researchers have warned against simultaneous presentation,

since the non-preferred food could become associated with the preferred food and diminish preferred food preference (Kerwin & Eicher, 2004).

It therefore seems apparent that behavioural interventions, including simultaneous and sequential presentation, can produce success in decreasing food selectivity in children with ASD, however which technique is able to produce the fastest and most superior results is unanswered with previous research producing conflicting results. Further, often EE is added following a lack of success in initial procedure, with only two participants from Piazza et al (2002) showing success with simultaneous presentation without EE, and only one of these showing success with sequential presentation without EE. No participants from the other comparison studies (Kern & Marder, 1996; VanDalen & Penrod, 2010; Garvey, 2011) were successful in decreasing feeding selectivity without the addition of EE, which given the associated negative side effects (Kerwin, 1999) is important. The goal of the present study is therefore to extend literature on the topic by comparing the effectiveness of simultaneous and sequential reinforcement without EE in decreasing food selectivity in children with ASD. The aim will be to conclude whether, without the use of EE, one technique is advantageous over the other. The successful technique will then have fading procedures applied to it, with the aim of the participants consuming the non-preferred food in the absence of preferred food. The success of the interventions will further be validated through the use of preference assessments as demonstrated by Penrod and VanDalen (2010). This research is necessary given the disparities that exist between previous research on the topic (Kern & Marder, 1996; Piazza et al, 2002; Garvey, 2011; VanDalen & Penrod, 2010). Finding a successful treatment for feeding selectivity in children with ASD will improve health, outcomes and quality of life for children with ASD and feeding selectivity, and their families (Piazza & Carroll-Hernandez, 2004).

Method

Participants

Three children with ASD and food selectivity participated. All were pupils at an independent special school in London that uses Applied Behaviour Analysis, and were recruited based on identification by school staff as having issues with feeding. A risk assessment was conducted (Appendix A), and information on the study provided (Appendix B). Informed consent was gained from the parents (Appendix C) and school (Appendix D) before participation. Ethical approval was gained from the School of Psychology Ethics Committee at Bangor University.

Nigel (real names not used) was 8-years old at the start of the study and has a diagnosis of ASD. Nigel was reported by his parents to have a selective diet, refusing all fruit and most vegetables (excluding cooked carrots and beans); he did eat a limited range of starches, proteins and dairy, including pasta, rice, milk, cheese and popcorn. Nigel is non-verbal and communicates using sign language; he exhibits a range of challenging behaviours including self-injury and aggression(Appendix E),.

Thomas was 9-years old with a diagnosis of ASD. Thomas was reported by his parents to have a selective diet, refusing all fruit and vegetables (excluding bananas); he did eat a limited range of starchy foods, including bread, pasta and rice cakes. Thomas is vocal, and communicates in short sentences; he displays a range of challenging behaviours including self-injurious, destructive and aggressive behaviours (Appendix F). Neither Nigel nor Thomas had previously partaken in any food programmes.

Simon was 8-years old with a diagnosis of ASD, atypical development and global delay. Simon was reported by his parents to have a selective diet, avoiding all hot or wet

food, with his diet mostly consisting of starchy foods such as bread, biscuits and crackers. Simon had previously been involved in an eating programme at his school, whereby simultaneous reinforcement (bread) and sequential reinforcement (iPad) were used to increase intake of cheese as a non-preferred food. Simon had made some progress with this, however still required reinforcement to eat the cheese. This was no longer running at the time of intervention. Simon uses a combination of one-word vocals and signing to communicate, and exhibits a range of low-level challenging behaviours (Appendix G).

Setting

The experiment was conducted at a table in the child's regular classroom. Sessions were conducted once a day during morning lesson time (between 10am and 10.45am), approximately 2 hours after breakfast, just before snack break and approximately 2 hours before lunch. Participants consumed snack and lunch as normal. The non-preferred food, preferred food, chosen tangible reinforcer (if relevant), and 2 plates were available during the sessions. Participants were not allowed access to their preferred food before the feeding session that day (1 hour), or for 2 hours following an unsuccessful feeding session. Throughout the research, parents were requested not to target the non-preferred foods at home to ensure there was no interference with the results.

Design

A multi-elements design was used. Initially an alternating treatments design was employed to compare the effectiveness of simultaneous and sequential presentation of preferred foods in increasing consumption of non-preferred foods. Following an initial

baseline phase, the two treatments (sequential and simultaneous) were alternated rapidly across sessions in a randomised order.

For Nigel a superior treatment phase was implemented, where the most effective treatment was applied to both foods so that the effects of the superior treatment could be assessed in isolation of the other treatment. The superior treatment phase was unsuccessful on the food that had previously been implemented in the sequential treatment, and therefore a novel food was introduced with the superior treatment. After successful implementation of the superior treatment, a changing criterion design was used to systematically increase the amount of non-preferred food consumed and decrease the quantity of preferred food.

For Thomas and Simon, a procedural adaptation was necessary due to no change in eating behaviour and an increase in challenging behaviour in the comparison phase. Following a period of assessing the participants' limits with the food, a changing criterion design was used to apply a graduated exposure hierarchy. The changing criterion design was applied to both foods, and the foods were alternated rapidly in a randomised order.

Measures

Prior to intervention two food preferences questionnaires were given to each child's parents to determine preferred and non-preferred foods, and to establish parental preference for foods to target (Appendix H&I). These foods were then used in a multiple stimulus without replacement (MSWO) preference assessment (DeLeon & Iwata, 1996) to verify participant's preferences, and identify one preferred food and two non-preferred foods for intervention. The non-preferred foods were allocated randomly to sequential or simultaneous conditions.

During baseline and the initial intervention, data collection involved categorising each instance of food presentation according to three criteria (1. The food was swallowed and no traces remained in mouth (i.e. clean mouth); 2. Some attempt to consume the food occurred; either food was consumed then expelled, partially consumed, or any other effort to consume that did not meet criteria 1 or 3; 3. The participant made no attempt to consume the food). The criteria, alongside any relevant comments were recorded on a datasheet (Appendix J). The dependent variable was the percentage of bites consumed which was calculated following classification by dividing the number of criteria 1 occurrences by the total number of bites presented, and multiplying by 100.

In the adapted procedure for Thomas and Simon, data collection involved categorising each instance of food presentation according to three different criteria (1. Imitates the correct response; 2. Any attempt to imitate the correct response that did not meet criteria 1 or 3; 3. No attempt to imitate the correct response) (see datasheet Appendix K). The dependent variable for Thomas and Simon was the percentage of correct responses which was calculated by dividing the number of criteria 1 occurrences by the total number of trials, and multiplying by 100.

Frequency and duration of challenging behaviours throughout the intervention were additionally recorded, with challenging behaviours classified due to participant-specific operational definitions (Appendices E,F&G).

Following the intervention, MSWO preference assessments were repeated with the same 12 foods to determine whether non-preferred foods had increased in preference, and additionally to probe generalisation for additional non-preferred foods not included in the intervention (Penrod & VanDalen, 2010). Parents of participants were presented with a social

validity questionnaire (adapted from Forehand, Wells & Griest, 1980) to assess the social validity of the procedures and outcome (Appendix L).

Procedure

Pre-treatment. Prior to treatment parents completed two food preference questionnaires (Appendix H&I), where they were asked to rate a range of starch, protein, vegetable, fruit and dairy foods into four categories (often eats, sometimes eats, never eats, used to eat but now does not eat), state which foods they would like their child to be offered, and rank their child's six most preferred foods. A MSWO preference assessment (DeLeon& Iwata, 1996) was then conducted to identify the preferred food and non-preferred food. In the preference assessment six non-preferred and six preferred foods were included (taken from the questionnaires), and a bite-sized piece of each of these twelve foods were presented together (Penrod & VanDalen, 2010). The participant was asked to choose a food, and upon selection, the remaining food items were covered and rearranged. The chosen food was not replaced, and following its' consumption, the participant was asked to choose another food. This process was repeated until either all items were selected or the participant failed to make a choice within 30 seconds. If the participant took a food item but spat it out this was not recorded as a choice. The preference assessment was repeated 5 times (DeLeon& Iwata, 1996), and a mobile application (Touch Autism, 2014) was used to calculate the percentage each food item was chosen. The food with the highest percentage was chosen as the preferred food, and the non-preferred foods were chosen from a combination of the preference assessment results and parental preference. The non-preferred foods were allocated randomly to either the simultaneous or sequential conditions. Table 1 outlines the preferred and non-preferred foods for each participant.

Table 1

Preferred foods and non-preferred foods as identified by the preference assessment and parental preferences

	Preferred Food	**Non-preferred food (Simultaneous)**	**Non-preferred food (Sequential)**
Nigel	Grated '*Cheddar'* cheese	Apple	Strawberry
Thomas	*'Digestive'* biscuit	*'Port salut'* cheese	Green grape
Simon	*'Go Ahead* 'Biscuit	Raw carrot	Cucumber

Baseline. A baseline phase was run to ensure no preference existed for the non-preferred foods that could confound results. During baseline, participants were offered the non-preferred food for 30 seconds, and it was recorded which criteria was met. Each non-preferred food had two separate baseline sessions, each including 5 trials. If the food was not accepted it was removed for 30 seconds before being presented for another 30 seconds. No prompts were used to encourage eating, and no consequences for eating or not eating were provided.

Simultaneous versus Sequential (Comparison Phase). Simultaneous and sequential conditions were alternated randomly across daily sessions. The research was conducted by either the researcher or a tutor familiar to the participant, and it was ensured that this was counterbalanced across conditions. All persons delivering the intervention received standardised training prior to intervention (Appendix M), and their performance was monitored using a procedural integrity checklist (Appendix N).

In the simultaneous condition, a piece of non-preferred food sized approximately 1cm^{2}was combined with two approximately 1cm^2 pieces of preferred food. These foods were presented together in a 'sandwich style' to the participant on a plate. For Nigel, (whose

preferred food was grated cheese),an equivalent amount was wrapped around the non-preferred food due to the consistency of the cheese. This meant that initially he could not see the non-preferred food. Following successful consumption of both the non-preferred and preferred food, verbal praise ("well done") was immediately provided.

In the sequential condition, a1cm^2 (approximately) piece of non-preferred food was presented to the participant on a plate. Another plate containing two approximately 1cm^2 pieces of preferred food was visible to the participant, and provided alongside verbal praise ("well done") following successful consumption of the non-preferred food. For Nigel the equivalent amount of grated cheese was provided on a plate.

In both treatment conditions participants were asked to 'try the food', and given 20 seconds to eat the non-preferred foods. This changed from baseline since it was observed that participants found the 30 second presentation period, and 30 second break too long and became restless. If consumption of non-preferred food was unsuccessful (criteria 2 or 3), the food was removed and participants were given a 20 second break with no reinforcement and no demands. Following successful consumption (criteria 1), participants were also provided with a 20 second break. After the 20 second break the food was presented in the same format and this sequence continued for 10 trials. Sessions continued to be alternated until at least one condition showed successful responding (over 90% criteria one), and this was stable for three data points.

If at any point the participant displayed challenging behaviour, the researcher did not attend to the challenging behaviour unless necessary to keep either themselves or the participant safe, and the experiment continued as planned. If an elevated rate of challenging behaviour occurred for three or more consecutive sessions, adaptations to the procedure were made.

Superior Treatment Phase. Following the comparison phase, Nigel's most successful treatment (simultaneous) was applied to both non-preferred foods to assess the effects of the superior treatment in isolation of the other treatment. The superior treatment phase was planned to be continued until stable and successful responding was demonstrated. If stable and successful responding was not demonstrated, reasons for this were investigated and procedural adaptations applied accordingly. For Nigel, a change of non-preferred food from strawberry to cucumber was applied as a procedural adaptation, since simultaneously presenting strawberry with cheese did not appear to be a desirable food combination.

Systematic Fading. Following the superior treatment phase, the ratio of Nigel's preferred to non-preferred food was faded for the most effective treatment (simultaneous). There were six steps planned for the fading phase, including a final stage where the non-preferred food is eaten in the absence of a preferred food (Appendix O). However due to time constraints from the school holidays, fading for Nigel involved only three steps. With the cucumber, Nigel successfully moved from one 1cm^2 piece of cucumber sandwiched between two 1cm^2 pieces of cheese, to one 2cm^2 piece of cucumber sandwiched between two 1cm^2 of cheese, and at the time of the experiment finishing was showing success with one 2cm^2 piece of cucumber sandwiched between two 0.5cm^2 of cheese. With the apple, a decrease in acceptance was seen during step 2 of the fading where the size of the piece of apple increased to 2cm^2. This was therefore reduced to a 1.5cm^2 piece of apple as an extra stage (Appendix O). Mastery criteria for each step was 3 sessions over 90% success.

Procedural Adaptations (Graduated Exposure hierarchy). For Thomas and Simon, an adapted procedure was introduced following the lack of success of the initial procedure and increase in challenging behaviour. The limit of their interaction with the non-preferred foods was tested, starting with the participants tolerating the item of food on a plate, then touching the food, and working through the 10-step hierarchy (Appendix P) until they

were unable to successfully imitate the response. This first point of failure was chosen as the starting point in the hierarchy. For Thomas this was licking both the cheese and the grape; and for Simon this was putting the carrot to his mouth, and licking the cucumber.

Sessions followed a similar structure to the initial procedure, however the participants were required to imitate a response with the food item (e.g., licking the food) for access to a preferred tangible item and preferred food (Thomas), or a preferred tangible item (Simon). Tangible items were chosen as the preferred foods identified via the preference assessment were not deemed to be reinforcing. Tangible reinforcers were selected based on observations of what the participant engaged with and was motivated by, and for both Thomas and Simon this was the iPad. Thomas additionally received a preferred food (digestive biscuit) as he requested it following the first few sessions of interacting with the food. Sessions lasted for 10 trials where participants were given 20seconds to imitate the response. Following successful imitation (criteria 1) participants received 20seconds with the tangible reinforcer, and following non-successful imitation (criteria 2 or 3) participants received a 20second break without access to reinforcement. Mastery criteria at each stage of the hierarchy was three sessions over 90% success. The experiment was planned to finish once participants had completed all 10 steps in the hierarchy and were able to bite the food in to two pieces and swallow both. Nevertheless due to time constraints from the school holidays the experiment terminated earlier. At the time of termination, Thomas was working on biting the grape in two, and biting the cheese in two and swallowing half; and Simon was working on biting both the cucumber and the carrot in two.

Post-treatment. Following the research, the multiple stimulus without replacement preference assessment was repeated. Parents were debriefed in writing (Appendix Q) and completed a social validity questionnaire (Appendix K). Had the experiment reached full

completion, generalisation of the results to other settings and people, in addition to individualised parent training would have been implemented.

Interobserver Agreement

During 27.8% of the sessions across all phases and conditions, an additional observer to the researcher simultaneously and independently scored responses. From this, interobserver agreement (IOA) was calculated by dividing the number of agreements by the total number of trials, and multiplying by 100. IOA showed 99.7% agreement for all participants.

Procedural Integrity

During 9.6% of intervention sessions, an additional observer used a checklist to monitor the implementation of the procedure (Appendix N). From this, procedural integrity was calculated as a percentage. Procedural integrity was 92.0% across all participants.

Results

Nigel

Figure 1 shows the percentage of bites consumed for Nigel during baseline, comparison, superior treatment and fading for apple, strawberry and cucumber (see Appendix R for tables of results). During the initial baseline phase Nigel consumed 0% of bites of both apple and strawberry, which increased immediately to over 90% for apple in the simultaneous

condition. Comparatively, consumption of strawberry in the sequential stage remained at 0%, spiking to 100% for one session before reverting back to 0%. Simultaneous presentation was therefore deemed the superior treatment, and applied to both apple and strawberry in the superior treatment phase. Nevertheless despite this, consumption of strawberry still remained at 0%. Additionally for one session consumption of apple reverted back to 0%, before increasing back up to 90%. Strawberry was terminated as a target food, and cucumber introduced to the superior treatment phase. During baseline Nigel consumed 0% of bites of cucumber, however during simultaneous presentation with cheese this increased immediately to over 90%.

Following success with the superior treatment (simultaneous), fading procedures were consequently applied to apple and cucumber. During the first stage of fading for apple, increasing the size from 1cm^2 to 2cm^2 caused an instant decrease in apple consumption to 0%. This slightly increased over the next 4 sessions, however failed to reach above 70% consumption. An additional fading step was therefore added, with a 1.5cm^2 piece of apple provided. This was immediately successful, increasing consumption to 100%. Nevertheless a dip to 0% occurred during one session, before returning back to 100%. Fading terminated after this point due to the school holidays. For cucumber, fading was much more successful, with consumption remaining above 90% with set increases in the size of cucumber, and set decreases in the size of the cheese (Appendix O). Nevertheless fading had to be terminated early due to the school holidays.

Figure 2 shows challenging behaviour for Nigel throughout the experiment. This was low throughout, however experienced one increased spike during the unsuccessful presentation of strawberry and cheese simultaneously in the superior treatment phase.

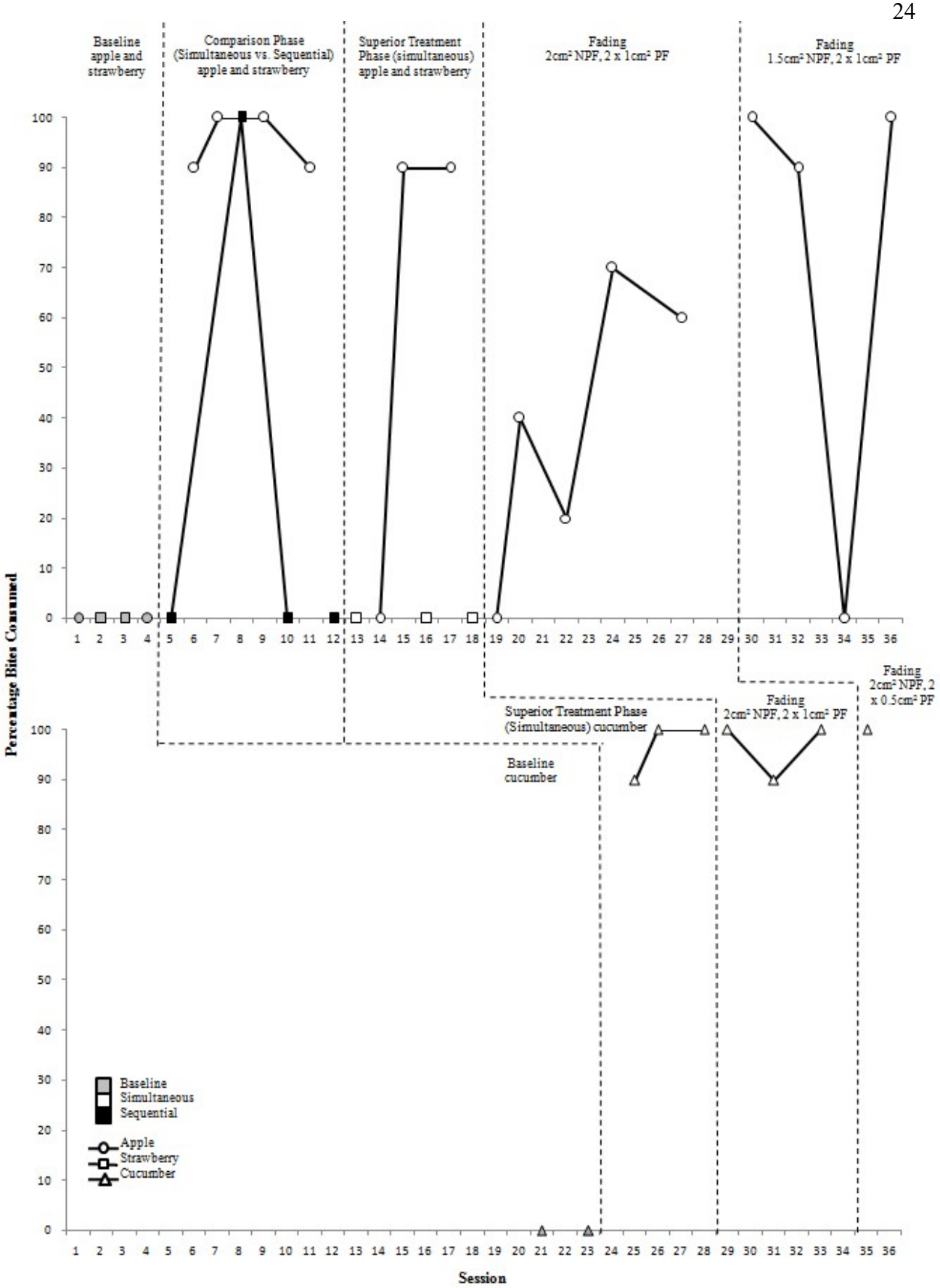

*Figure 1:*Percentage of bites consumed for Nigel across baseline, comparison phase, superior treatment phase and fading

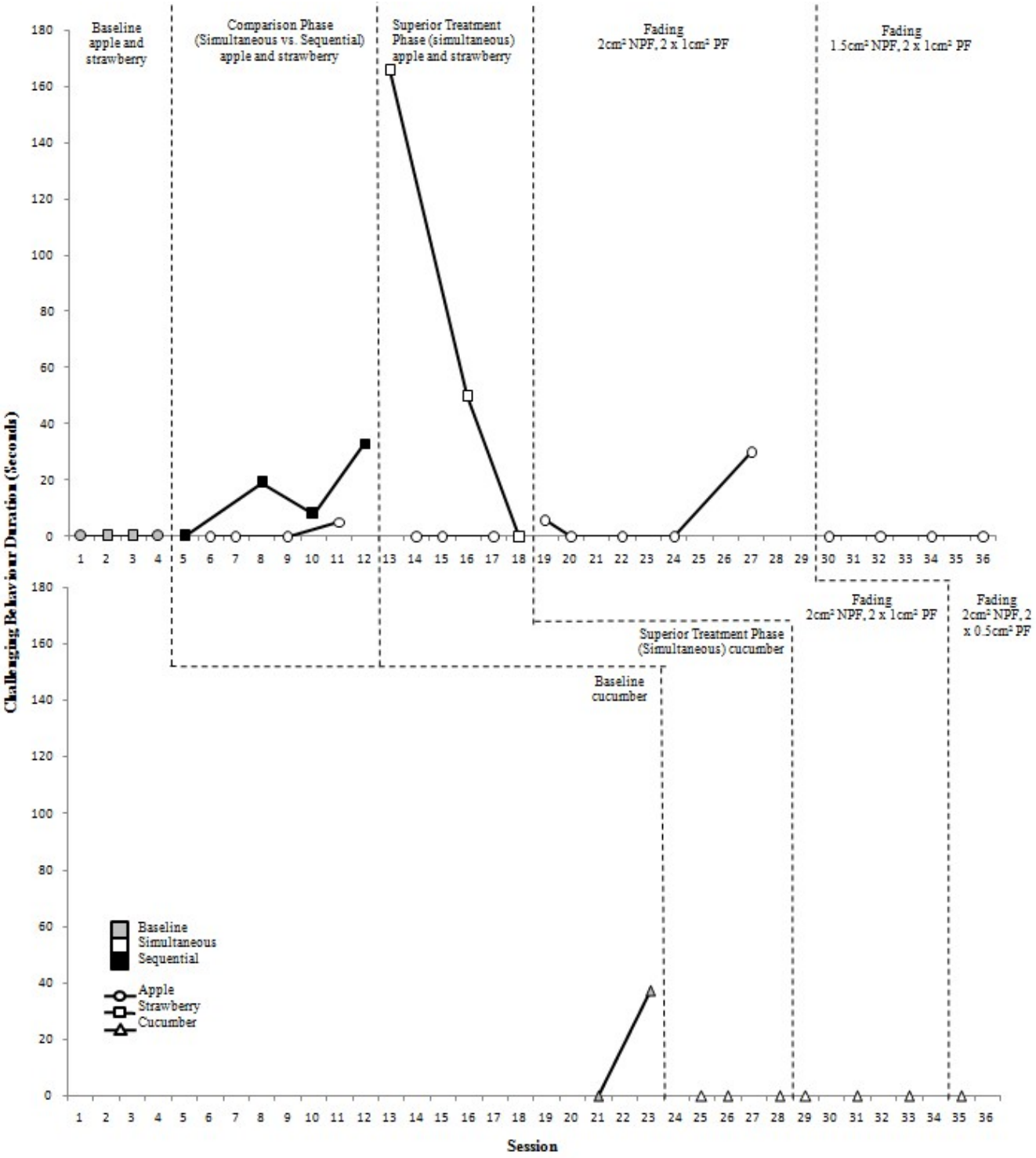

Figure 2: Duration of challenging behaviour in seconds displayed by Nigel throughout baseline, comparison, superior treatment and fading

Thomas

Figure 3 shows the percentage of correct responses during baseline, comparison (simultaneous versus sequential) phase and the graduated exposure hierarchy for Thomas (see Appendix R for tables of results). During baseline and comparison phase the correct response was consumption of the target food, and at baseline this was 0%. During the sequential presentation phase consumption remained at 0%, and during simultaneous presentation it remained below 30%. Figure 4 shows the duration of challenging behaviour exhibited by Thomas throughout the experiment, and it can be seen that during the comparison phase Thomas displayed an elevated duration of challenging behaviour, peaking at 2340 seconds (39 minutes). This challenging behaviour was exhibited in the forms of aggressive, self-injurious and destructive behaviour, and therefore the procedural adaptations occurred as a consequence of this.

Following a period of assessing Thomas' limits with the foods (not graphed), it was found that he was unable to lick the food. Figure 3 shows that when implemented in the graduated exposure hierarchy and followed by reinforcement, Thomas was able to successfully lick both the cheese and grapes on 100% of trials. Moving through the hierarchy Thomas successfully was able to place both foods on his tongue, touch teeth together on both pieces of food, and bite the cheese in to two pieces on 90% or more of trials. Biting the grape in to two pieces was accompanied by an increase in challenging behaviour and correct responses decreased to 0%. Additionally biting the cheese in to two pieces and eating one half was accompanied by an increase in challenging behaviour and correct responses decreased to 10%. At this point the experiment was terminated due to the school holidays.

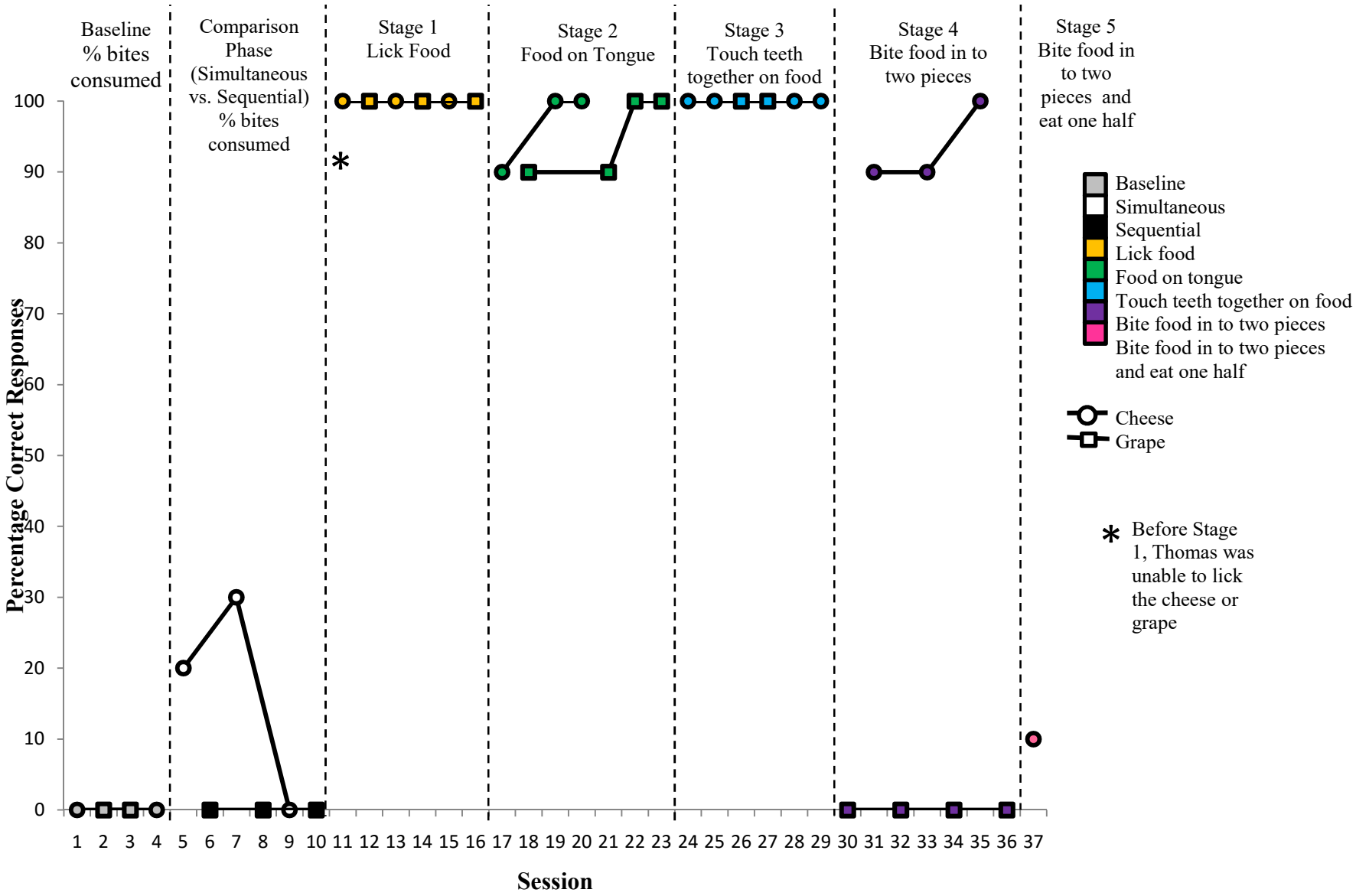

Figure 3: Percentage of correct responses for Thomas across baseline, comparison phase and the graduated exposure hierarchy

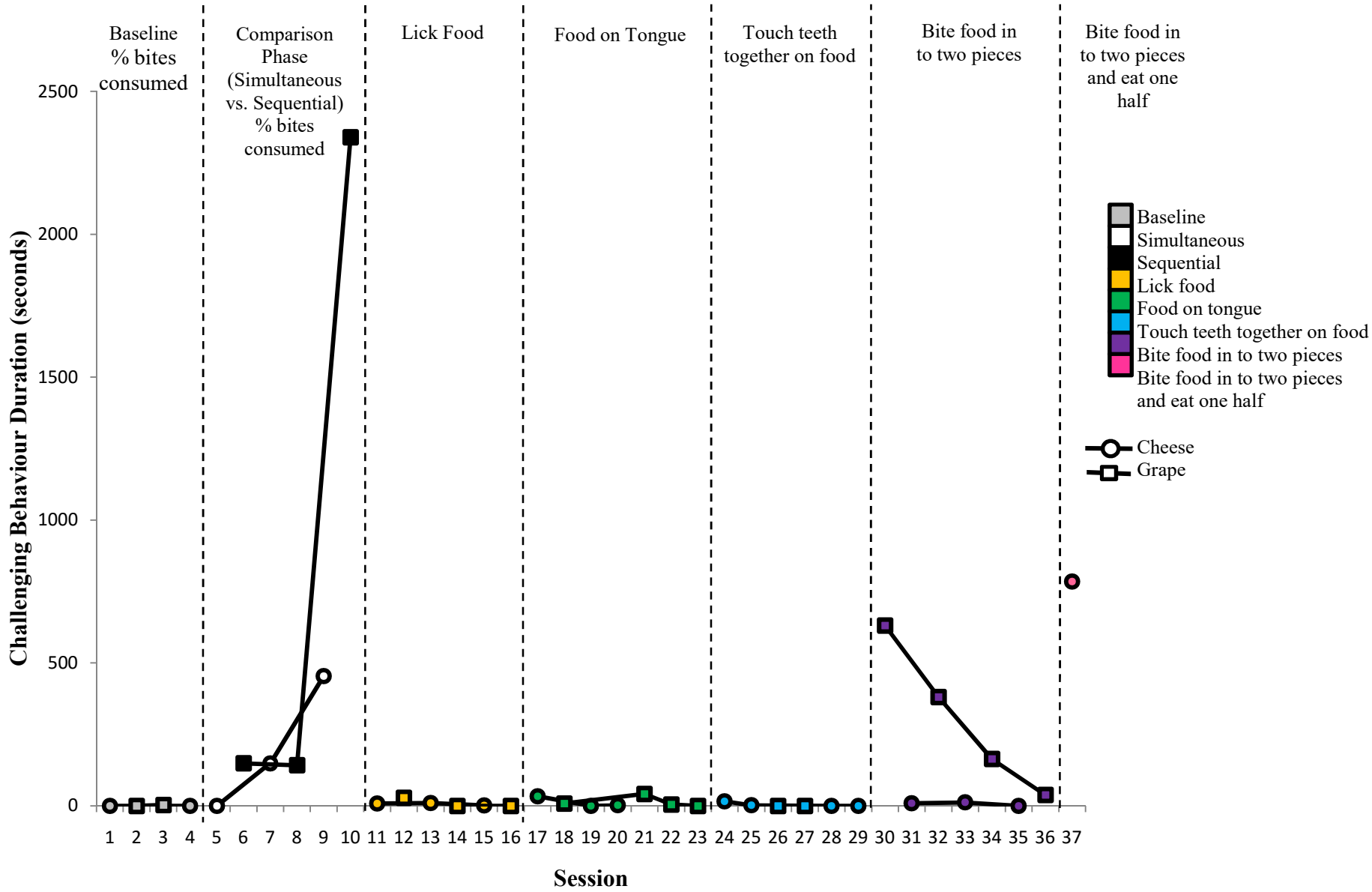

Figure 4: Duration of challenging behaviour in seconds displayed by Thomas across baseline, comparison phase and the graduated exposure hierarchy

Simon

Figure 5 shows the percentage of correct responses during baseline, comparison (simultaneous versus sequential) phase and the graduated exposure hierarchy for Simon (see Appendix R for tables of results). At baseline consumption of bites was 0%, and for both simultaneous and sequential presentation this remained at 0%. This was additionally accompanied by an increase in the duration of challenging behaviour to 242 seconds (4 minutes 2 seconds) as shown in Figure 6, and therefore procedural adaptations were employed.

Following a period of assessing Simon's limits with the foods (not graphed), it was found that he was unable to lick the cucumber and unable to put the carrot to his mouth. Figure 5 shows that when followed by reinforcement, Simon was able to successfully move through the hierarchy; putting the carrot to his mouth, licking the cucumber and carrot, putting the carrot and cucumber on his tongue, and touching teeth together on the carrot and cucumber on 90% or more of trials. Biting the cucumber in half decreased correct responses to less than 30% and was accompanied by an elevated rate of challenging behaviour. Biting the carrot in half had promising first results, however the experiment had to be terminated at this point due to school holidays.

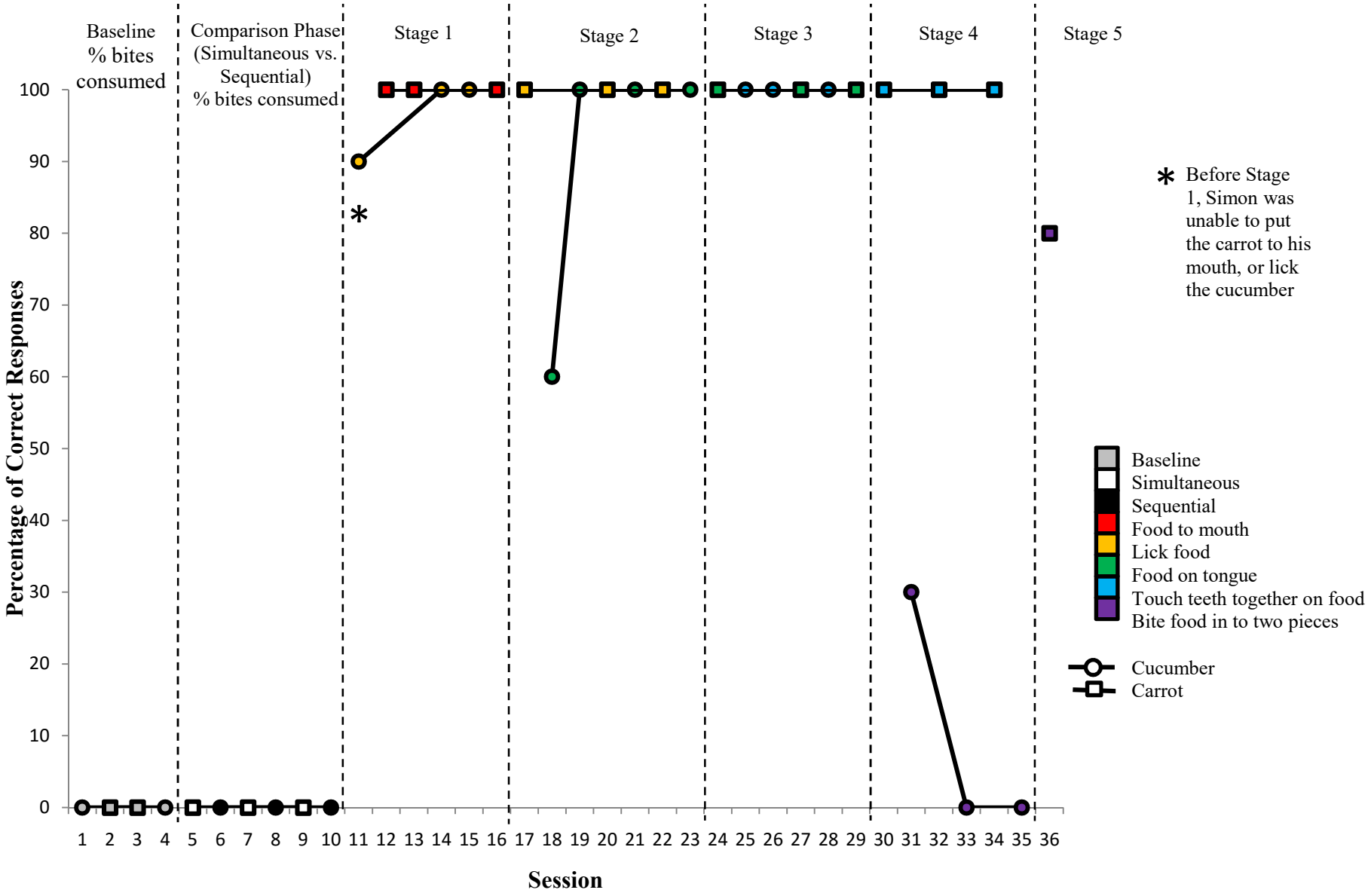

Figure 5: Percentage of correct responses for Simon across baseline, comparison phase and the graduated exposure hierarchy

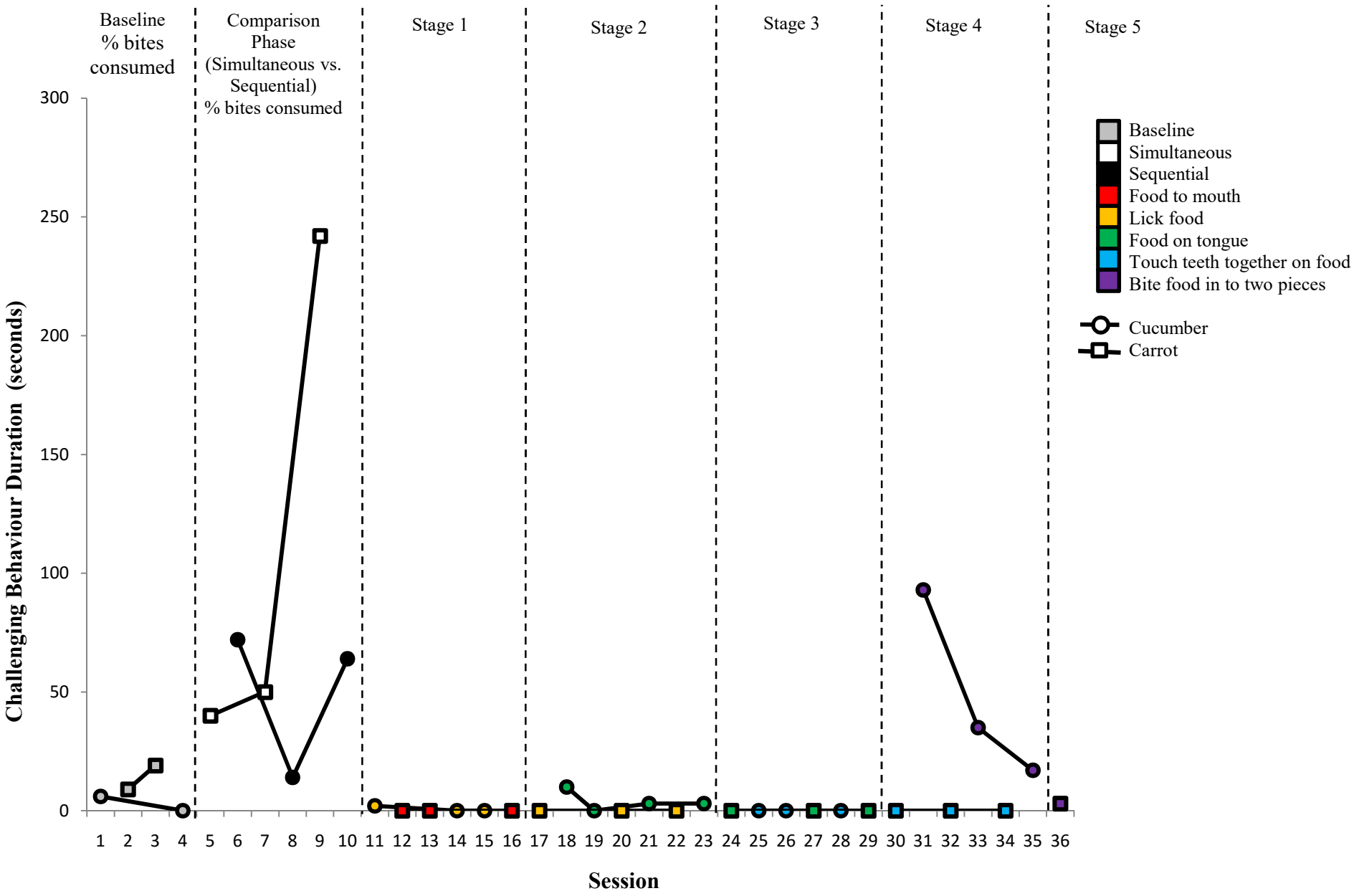

Figure 6: Duration of challenging behaviour in seconds displayed by Simon across baseline, comparison phase and the graduated exposure hierarchy

Preference Assessments

Figures 7, 8 and 9 show the pre- and post-experiment preference assessment results for Nigel, Thomas and Simon respectively. For Nigel it can be seen in Figure 7 that pre-experiment, cheese was consistently chosen as the most preferred food item, and he did not choose any of the non-preferred food items. Post-experiment Nigel chose the cheese sandwich first, and the cheese second on all trials. He failed to choose any of the non-preferred food items including apple, cucumber and strawberry.

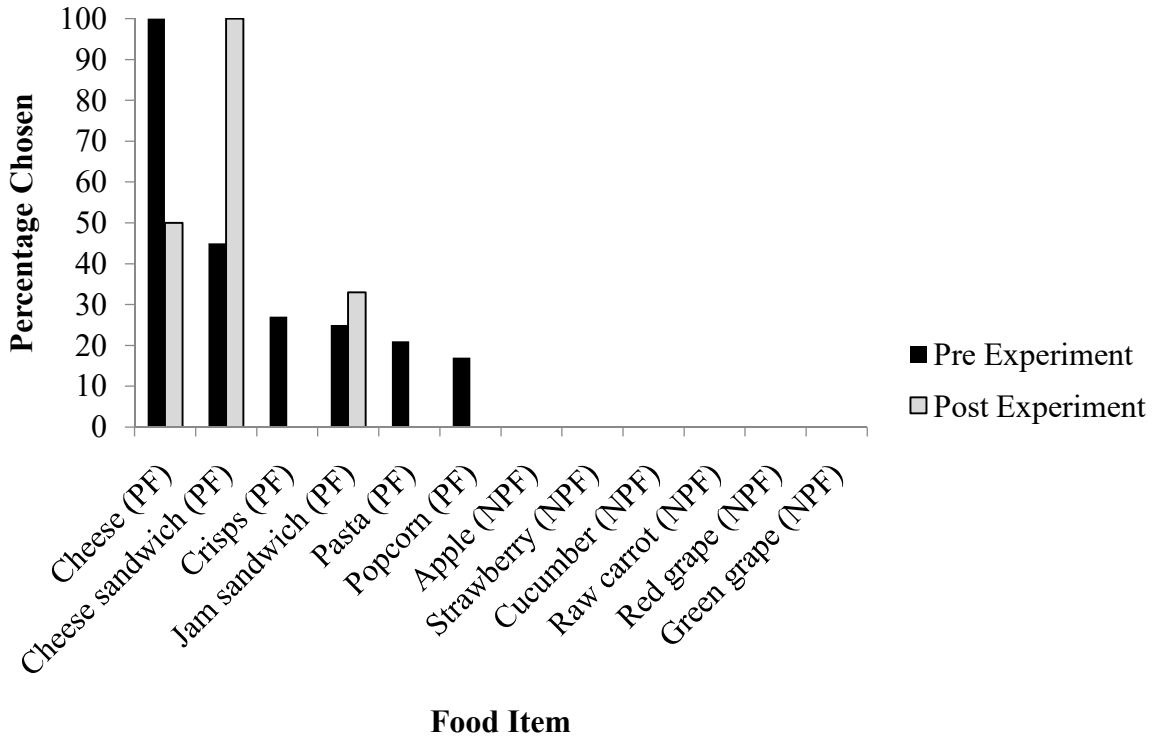

*Figure 7:*Results of the preference assessment showing the percentage each preferred food (PF) and non-preferred food (NPF) items were chosen for Nigel pre- and post-experiment.

For Thomas Figure 9 shows that digestive biscuits were found to be the most preferred food item pre-experiment, however these were only chosen on 71% of occasions. No non-preferred food items were chosen pre-experiment. Post-experiment cream biscuits

were chosen first by Thomas on 100% of trials, with digestive biscuits consistently chosen second, and caramel biscuits consistently chosen third. Thomas did not choose the rest of his preferred or non-preferred food items, including grapes or cheese.

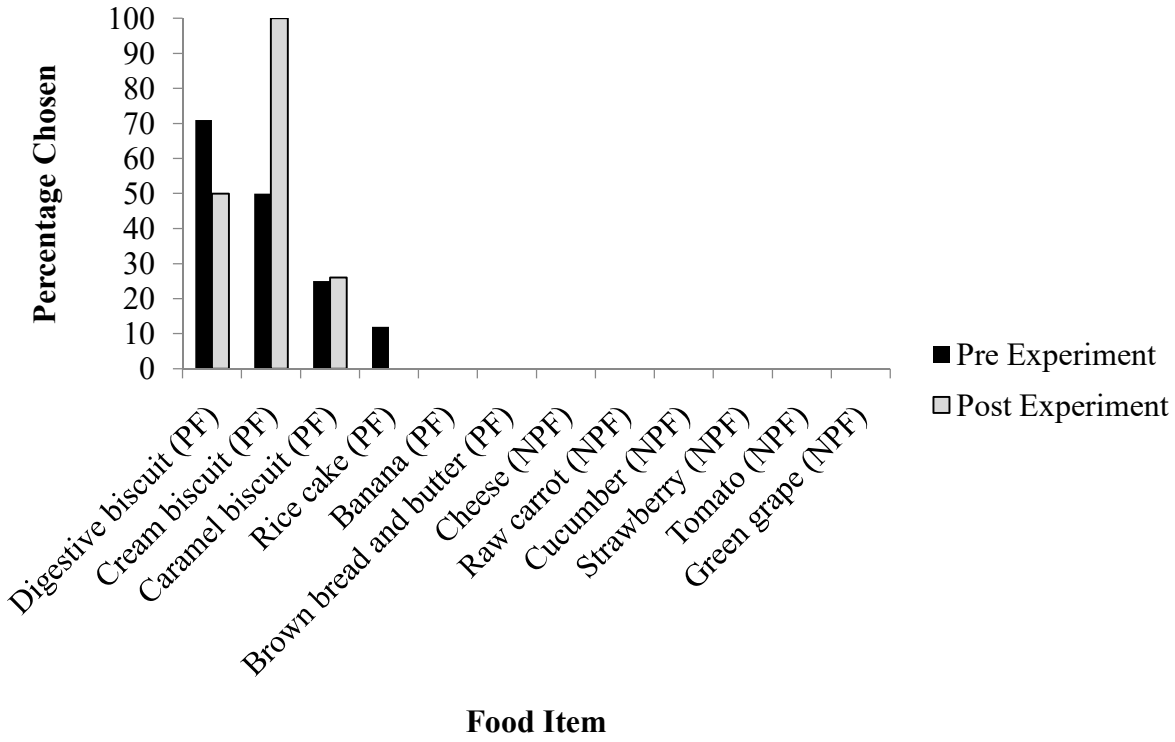

*Figure 8:*Results of the preference assessment showing the percentage each preferred food (PF) and non-preferred food (NPF) items were chosen for Thomas pre- and post-experiment.

For Simon Figure 10 shows that 'go ahead' biscuits were found to be Simon's most preferred food item pre-experiment, however these were chosen on just 62% of trials. Pre-experiment Simon tried cucumber and carrot on one occasion, however did not try any of the other non-preferred food items. Post-experiment digestive biscuits were the most preferred food item, and Simon failed to choose any of the non-preferred food items, including carrot or cucumber.

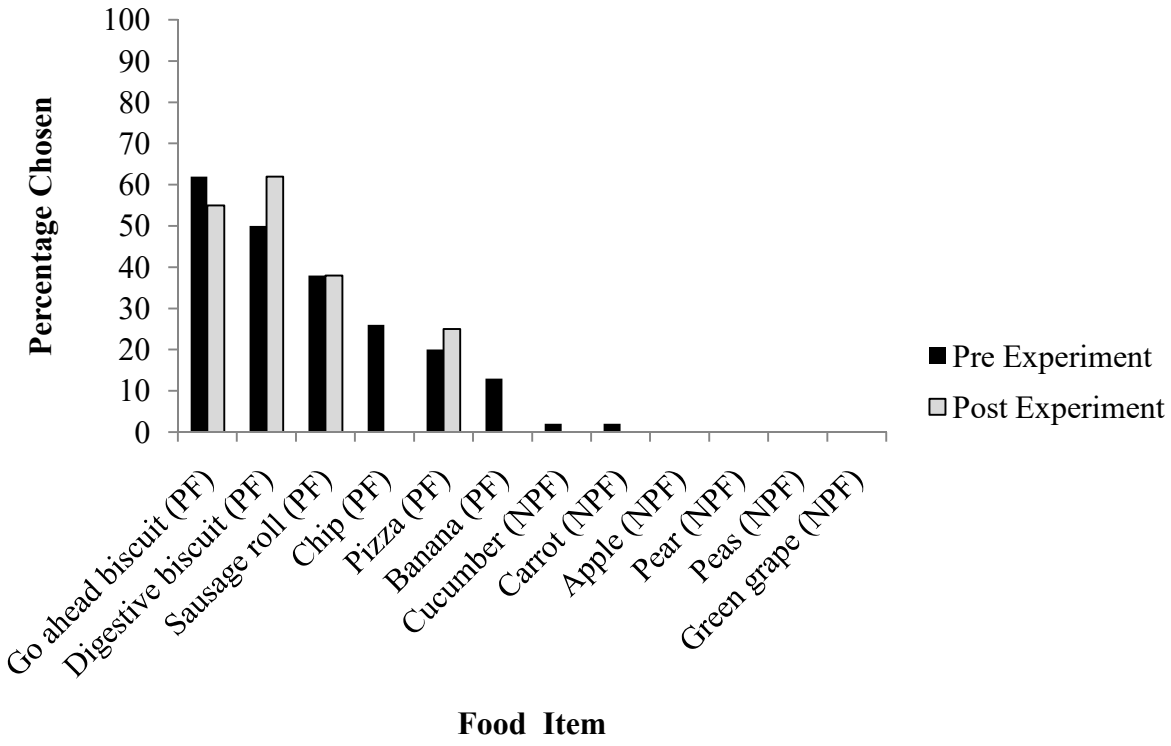

*Figure 9:*Results of the preference assessment showing the percentage each preferred food (PF) and non-preferred food (NPF) items were chosen for Simon pre- and post-experiment.

Social Validity Questionnaire

Following the experiment, participants' parents rated the experiment on a number of aspects relating to social validity. Table 2 shows parents answers to the questions, rated on a likert scale from 1 to 7.

Table 2

Results from the social validity questionnaire for Nigel, Thomas and Simon

	Nigel	Thomas	Simon
Before the study my child's acceptance of the target food was (1-significantly worse; 7-significantly better)	1	3	3
Following the project, my child's acceptance of the targeted foods was (1-significantly worse; 7-significantly better)	6	4	7
How confident are you introducing new foods to your child (1-very unconfident; 7- very confident)	4	4	6
I feel that the successful approach reported by the researcher in helping my child's food selectivity is (1- not appropriate; 7-very appropriate)	7	3	6
At this point I feel participation in the study was (1-extremely unhelpful; 7- extremely helpful)	7	5	7

Discussion

This study set out to conclude whether, without the use of EE, simultaneous or sequential reinforcement is more effective in increasing eating in children with ASD and feeding selectivity, and whether systematic fading procedures can be applied to this successful method to result in the participant consuming the non-preferred food in the absence of the preferred food. The study produced mixed results, finding simultaneous presentation to be advantageous in one participant, however neither technique effective for two participants. For the successful participant (Nigel) the ratio of preferred to non-preferred food was able to be faded, however there was insufficient time to eliminate the preferred food completely. For the two participants where neither of the treatment conditions were successful (Thomas and Simon), procedural adaptations were applied. Consequently, the study's secondary aim was to investigate whether a graduated exposure hierarchy, without EE, would be beneficial for these participants. The study found that the graduated exposure

technique was successful in increasing participant's interactions with the non-preferred foods, however there was insufficient time to move to the point of the participant consuming these foods.

The results from Nigel support findings by Piazza et al (2002) whereby two of three participants had more success with simultaneous than sequential reinforcement in the absence of EE. The results additionally uphold Ahearn (2003) whereby vegetable consumption was increased through simultaneous reinforcement in the absence of EE, and follow the same pattern as Kern and Marder (1996) who showed simultaneous reinforcement to be advantageous over sequential, albeit also using EE. These results do however contrast to findings by VanDalen and Penrod (2010) and Garvey (2011) where sequential reinforcement alongside EE was found more advantageous than simultaneous. Interestingly though, although simultaneous reinforcement was shown to be a successful method for Nigel, increasing consumption of both apple and cucumber, it failed to work for strawberry. This adds support to the idea that the foods used in simultaneous reinforcement must be compatible (VanDalen & Penrod, 2010). Nigel's preferred food was cheese, which can be eaten alongside apple or cucumber, however is an undesirable combination alongside strawberry. Nigel consumed 0% of the bites of strawberry presented with cheese, and additionally showed an elevated rate of challenging behaviour during these sessions. Further the first session with strawberry appeared to consequently affect the following days' session with apple where despite previous successes Nigel failed to consume any of the bites offered to him. Compatibility of foods therefore seems to be an important issue that could lend itself to future study.

The success of simultaneous reinforcement for Nigel with apple and cucumber, and previous successes shown with simultaneous reinforcement (e.g., Piazza et al, 2002, Ahearn, 2003; Kern & Marder, 1996), have been suggested due to one of two mechanisms; flavour-

flavour learning or motivating operations. Flavour-flavour learning involves an increase in preference for a flavour that has been paired with another flavour (Capaldi, 1996). Although Nigel showed preference to simultaneous over sequential reinforcement, it is unlikely that flavour-flavour learning is responsible for this change, as when these food items were presented in the absence of the preferred foods in the final preference assessment Nigel did not consume them (Piazza et al, 2002). It is therefore likely that motivating operations are at play, and as such the presence of the cheese decreased Nigel's motivation to escape as the non-preferred foods were perceived as less aversive (Piazza et al, 2002). This presumes that the food selectivity is maintained by negative reinforcement (Bachmeyer, 2009), nevertheless one flaw of the current experiment is that no functional analysis was conducted to confirm this. Future research should include a functional analysis to confirm the maintaining function of that particular individual's food selectivity.

Motivating operations might also explain why neither simultaneous or sequential reinforcement was successful for Thomas or Simon, as the reinforcement was not sufficient to reduce the aversiveness of the demand. Cooper et al (1999) showed that children chose to eat foods associated with greater quality and quantity of reinforcement, and therefore the magnitude of reinforcement available is important. The results of the initial preference assessments showed that cheese was chosen first by Nigel 100% of the time, and therefore is likely to function as a reinforcer. Nevertheless the chosen edible reinforcers for Thomas and Simon achieved 71% and 62% respectively. Fisher et al (1992) used a selection criterion of over 80% to typify a preferred stimulus in a paired stimulus preference assessment, and although there are no set criterions for a MSWO preference assessment as it is harder to classify (DeLeon & Iwata, 1996); results of the current study suggest that the chosen preferred food items did not function as reinforcers. Although the participants were deprived of their preferred food item before and after feeding session with the aim of increasing

reinforcement effectiveness (Levin & Carr, 2001), there is a possibility that Thomas and Simon are not motivated enough by any food for it to function as a reinforcer and compete with the demand of consuming a non-preferred food. Although a MSWO preference assessment was used to systematically assess preferences, which is one of the most efficient ways to successfully identify reinforcers for people with disabilities (Tullis, Cannella-Malone & Fleming, 2012), perhaps the preference assessment did not contain items that would be highly preferred to Thomas and Simon. Often preference assessments with a combination of tangible and edible items yield different results to those with just edible items in (DeLeon & Iwata, 1996), and therefore it would have been useful to conduct a preference assessment with a combination of items to successfully identify a reinforcer. Evidently in the latter part of the experiment Thomas and Simon were reinforced by tangible items, however a flaw here was that a preference assessment was not used to identify these items. Further all participants showed fluctuations in responding throughout the experiment and this might have been due to changes in preference during the experiment. It was anecdotally reported that during some sessions where 0% criteria one was achieved, participants appeared to have a decreased motivation for their preferred items. Preferences have been demonstrated to alter over time (Higbee, Carr & Harrison, 2000), and therefore it would have been advantageous to assess preference frequently throughout the experiment in order to identify the current most reinforcing item. Logistically however this may prove complex.

Another reason that could have contributed to the differences in results is the visibility of the non-preferred food in the simultaneous condition. Due to the consistency of the grated cheese Nigel was unable to see his non-preferred food, whereas to Thomas and Simon it was visible. Similarly in Piazza et al's (2002) experiment one participant was unable to see the non-preferred food, and they had more success with the simultaneous method. It is possible that since the food was hidden in the simultaneous condition but visible in the sequential

condition, that this might have been the reason why Nigel showed preference to the simultaneous method (VanDalen & Penrod, 2010). Further for Thomas and Simon, as mentioned above, it appears that the reinforcement was not sufficient to compete with the aversiveness of the non-preferred food. It would be interesting to see whether if their non-preferred food had also been hidden whether they too could have had success with the simultaneous method. This could be a subject for future research.

Not only was neither simultaneous or sequential reinforcement effective for Thomas and Simon, but the treatment conditions also considerably increased challenging behaviour. Given these increases, it would have been unethical to continue with the intervention, and therefore procedural adaptations were applied. Whilst the risk assessment (Appendix A) predicted that challenging behaviour might cause a risk to both the participants and the researchers, and aimed for management of these risks through the presence of trained individuals, it did not have a plan in place for extended periods of challenging behaviour. It was decided that following three sessions with elevated challenging behaviour that procedural adaptations would be applied. Future risk assessments should clearly include plans for such incidences in order to safeguard the participants.

The adapted method did however reduce levels of challenging behaviour to low levels, and further showed success with increasing Thomas and Simon's interactions with the non-preferred foods. This has added support to literature showing graduated exposure methods to increase contact with foods without the need for EE (Tanner & Andreone, 2015; Koegel et al, 2011). Reducing the demand meant that motivation to escape it was reduced, and participants were willing to comply to receive reinforcement (Tanner & Andreone, 2015). One flaw with the procedural adaptation however is that it is unclear which aspect of the change was responsible for the initial success for Thomas and Simon. Both the type of reinforcer was changed from edible to tangible, as well as the demand reduced. Future

research would look at changing one aspect at a time in order to be able to see which component is accountable for the change. Additionally, unlike previous research, the current study was unable to get Thomas and Simon to the point where they were able to consume new foods. There are two reasons why this might have been the case. The first could be due to the magnitude of reinforcement, since as the level of the demand increased Thomas and Simon's compliance with demands decreased. The study ended with Thomas and Simon both currently not achieving the success criteria for their present hierarchy step. This could be that as the demand increased, the magnitude of reinforcement needed to increase also (Hursh, 1980). This is something that had the experiment continued would have been considered. The second reason is the time frame of the study. Although the project spanned 4 months, some of this time was spent comparing the unsuccessful simultaneous and sequential methods and therefore only 2 months was spent dedicated to the graduated exposure hierarchy. Previous experiments have spanned a much longer period than this, with Koegel et al (2011) running their study over 22 weeks, and Tanner and Andreone (2015) taking 9 months. Given the placement of the school summer holiday and realities associated with conducting applied research in a school, it was not possible to complete all stages of the hierarchy.

Another aspect of the study that was impeded by time was the results of the fading procedures for Nigel. It was planned that the ratio of the non-preferred food to preferred food would be gradually changed across 6 steps, resulting in Nigel eating the non-preferred food in the absence of the preferred food, however this was not possible due to the occurrence of the summer holidays. Additionally for apple, Nigel struggled moving to the first fading step and an additional step had to be put in. Although simultaneous reinforcement proved an initially rapid intervention to increase Nigel's intake, to reach a point where the eating is practical for Nigel (i.e. you don't need cheese every time he has cucumber) is lengthy. Not using EE might therefore mean that progress within feeding interventions is more time-consuming.

Nevertheless given time is not an issue, making gradual changes without causing additional stress or disruption to the participants may be preferable over more restrictive practices using EE (Kerwin, 1999). Further given that the study was unable to reach completion, planned generalisation to other settings and people, as well as parent training to continue with the intervention at home, was unable to be implemented. Despite this lack of generalisation however, parent responses to the social validity questionnaire were mostly positive. Nigel and Simon's parents reported that food acceptance at home had increased, and participation in the study was extremely helpful and appropriate. For Thomas, food acceptance is similar to before however parents still believed that participation in the study was beneficial.

Another benefit of the current study is that positive results were gained without the use of EE. This adds to previous research showing that EE is not a necessary component to produce positive change (Bachmeyer, 2009). This is especially important since EE can be considered restrictive and intrusive, often accompanied by negative side effects such as increased challenging behaviour and an extinction burst (Kerwin, 1999). Given the increase in challenging behaviour exhibited by Thomas and Simon during simultaneous and sequential reinforcement in the absence of EE, it is likely that had EE been applied an extinction burst would have occurred, which would have been both unmanageable and unethical. This study shows the importance of practitioners to try antecedent strategies and/or positive reinforcement techniques before considering EE (Kerwin, 1999). Another ethical consideration is that during simultaneous reinforcement the association between the non-preferred and preferred foods could have acted to diminish the preference of the preferred food (Kerwin & Eicher, 2004). Although Nigel's preference for cheese during the preference assessment decreased from being consistently chosen first pre-intervention, to consistently being chosen second post-intervention, it is unlikely that the association occurred negatively as the first preference post-intervention was the cheese sandwich, thus also containing cheese.

Overall although not accomplishing what it set out to achieve, the results of the present study provide support that antecedent and reinforcement based procedures can produce some success in increasing interactions with food for children with ASD and feeding selectivity without the need for EE. For Nigel simultaneous reinforcement proved successful in rapidly increasing consumption of compatible non-preferred foods, and although fading the reinforcement was a lengthy process, the participant was beginning to show success with this. The other 2 participants showed some initial success with a graduated exposure hierarchy, moving towards being able to successfully touch their teeth together on the foods. Again time was an issue here, and future research might want to investigate whether there are less time consuming approaches that still avoid EE. Future research should also take the form of investigating whether visibility of food and compatibility of food are important in simultaneous reinforcement, and whether conducting more frequent preference assessments and adapting reinforcement alongside increased demands will produce more success for participants. Feeding issues remain a complex issue (Marí-Bauset et al, 2013), and research in to what works and doesn't work is incredibly valuable. As highlighted by this research, individuals with ASD have many individual differences, and whilst this means that there is limited scope for these results to be generalised across children, the results have been beneficial for these particular children and their families.

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Appendix A: Risk Assessment

BeyondAutism

Comparing simultaneous versus sequential feeding procedures in reducing food selectivity in children with Autism

Risk Assessment

1. Risk to participants

Risk	**Management of the risks**
A) As this study involves the presentation of new food, there is a risk that participants may have allergic reactions.	A) Allergy screening will be included in the parental consent form.
B) There is a risk the participant may choke on food given during the study.	B) The participant will be in control of placing the food in his or her own mouths, no force-feeding will occur. In the event of choking there will be at least two named members of staff, trained in first aid, on site who will be aware of the study, times of sessions etc. Water will be available at all times.
C) There is a risk the participant may involuntarily vomit as a result of food presentation, acceptance or consumption.	C) If vomiting occurs the session will be terminated and the child will be assessed by someone trained in first aid. School policy guidelines will be used for the safe clearance of the area
D) There is a risk the participant may induce vomiting upon food presentation, acceptance or consumption.	D) As above

E) There is a potential risk a participant may engage in Self-Injurious Behaviour (SIB), aggression (hitting others), throwing to avoid food acceptance/consumption.	E) The time interval of food presentation is purposefully limited to 30 seconds, after which the food is removed therefore decreasing the motivation for disruptive behaviour to occur. At no point will food be placed in the participant's mouth by the investigator. In the event that challenging behaviours occur, the usual procedures will be implemented. The investigator is trained in ABA and in the procedures to manage occurrences of such behaviour. Additional members of staff will also be available to call upon for assistance.
F) There is a risk that the child may suffer injury trying to resist neutral guidance back to the eating area.	F) Neutral guidance is defined as the physical guidance in the least intrusive manner necessary to redirect the participant. Participant will not be physically picked up or forcefully directed therefore minimising the risk of injury.
G) There are potential risks associated with food preparation and hygiene e.g. cross-contamination and potentially dangerous equipment such as knives.	G) There is already a food hygiene policy in the school; this will be adhered to throughout the study. All food will be in date and stored correctly. The participant and investigator will wash their hands thoroughly prior to and after each session. If the investigator or participant shows signs of illness the session will be postponed.
H) The participant has a diagnosis of Autistic Spectrum Disorder (ASD). He has limited communication and understanding skills. There is a potential risk that participants may not understand the intentions of the study, be able to effectively express consent or communicate the desire to withdraw from the study.	H) Consent will be obtained under the ethical guidelines as stated by the Behaviour Analyst Certification Board. The investigator is familiar to the participant, as he/she is part of the class staff and works with the participant on a regular basis.
I) Pairing the foods in the simultaneous condition may diminish the participants preference for the preferred food.	I) Data will be observed closely and if at any point the procedure is not effective, the procedure will be terminated.

2. Risk to investigators

Risk	Management of the risks
Risk of violence, or other harm	
A) There is a risk of injury to investigators as a result of aggressive behaviour from participants.	A) The time interval of food presentation is purposefully limited to 30 seconds, after which the food is removed therefore decreasing the motivation for such behaviour to occur. The investigator is experienced in anticipating such behaviour and competent in minimising the risk of injury through altering posture and proximity.
B) There is a potential risk of confrontation from parents.	B) Parents will have been given a detailed information sheet describing the whole study and consent will have been gained prior to the study beginning. They will have had prior opportunities to voice concerns or ask any questions. The parent has the right to withdraw their child from the study at anytime.
C) There is a potential risk of confrontation from other members of staff.	C) Staff members will have been fully briefed about the study and will have the opportunity to voice any concerns prior to the study beginning.
D) There is a risk the investigator could suffer allergic reactions to food used in the study.	D) The investigator has no known allergies but as a precaution, only previously consumed food will be used.
E) There are potential risks associated with food preparation and hygiene	E) There is already a food hygiene policy in place at the school; this will be adhered to throughout the study. All food will be in date and stored correctly. The participant and investigator will wash their hands thoroughly prior to and after each session. If the investigator or participant shows signs of illness the session will be postponed.
Risk of allegations	
F) There is a risk of allegations from participants/participants parent's and other staff members.	F) All sessions will take part with a minimum of two adults present at all times, which will protect the investigator against any allegations

Appendix B: Parents Information Sheet

Comparing simultaneous versus sequential feeding procedures in reducing food selectivity in children with Autism

Parents information sheet

Information about the study

The purpose of this study is to look at different ways of presenting food which children like (preferred) or dislike (non-preferred) in a school setting. Children with Autism can be very selective about the intake of certain food. Behaviour based intervention strategies have proven to be an effective method to treat such problems. Most strategies include an element of positive reinforcement. This study could potentially help to improve your child's intake of various foods and provide a more nutritionally balanced diet. Furthermore, it might help your child and the family to have meals outside of the house.

Why has your son/daughter been invited?

Your son/daughter has been invited to take part in the study because you have a child with Autism who is selective about his/her food choice. We would like to explore whether different ways of presenting food will help improve the intake of non-preferred food. We will be inviting other pupils within the school to take part in this study.

What does the study involve?

If you would like your child to take part in this study, we will first ask you to fill out a questionnaire to indicate what food your son/daughter likes or dislikes. From this questionnaire the researchers will select two different foods to be targeted for increased consumption. The researchers will also identify a favourite/preferred food that will be used to assist with this process. The study will take place at your child's school during allocated slots. The intervention will not take place during snack or mealtimes to avoid interruption of existing food programmes. During the allocated slot, your child will be presented with food in one of two manners. The different foods will be presented in separate sessions. One of the chosen non-preferred foods will be presented at the same time as their chosen preferred food (simultaneous food presentation). The other non-preferred food will be presented alone, with their preferred food presented once they have eaten the item (sequential food presentation). For example, if your child does not like sweetcorn and peas, then in all sequential food presentations sweetcorn will be used, and all simultaneous food presentations peas will be used. The same preferred food will be used in both food presentations interventions. Verbal praise will be given when your child is successful. In both sessions, the piece of non-preferred food will initially be very small (e.g. 1cm).

After the intervention the intake of non-preferred food will be increased and the intake of preferred food will be decreased to generalise food intake. This process is called fading. School staff familiar to your son/daughter will be taught by the researcher to conduct the intervention. School staff will take data and the researchers will assess the data. It is important to highlight that he/she will be encouraged using positive language to eat the food item, but your child will not be forced to eat anything they do not choose to eat. Each session will be a maximum of 20 minutes. The full study will run over approximately six months. After completion of the study you will be asked to fill out a satisfaction questionnaire.

We would appreciate if you could wait with trying the procedure and/or new foods at home until we have finalised the research. The researchers will inform you about the results and they are willing to help you to introduce it at home if of interest.

What are the costs?

Participation of the study itself is free of charge. However, you might be asked to send in some extra preferred and non-preferred food for your son/daughter.

What are the possible risks and benefits of taking part?

Familiar staff members will conduct the study during school times. As mentioned above, we will use positive approaches from ABA to support your child. The study will be conducted according the school guidelines and we do not anticipate any major risks. We cannot be certain that your child will benefit directly from taking part, but similar research that has been conducted has tended to increase the amount and the variety of foods that children will choose to eat.

Do I have to take part?

Participation to this study is at your full discretion. If you decide to take part we will send you a parent consent form and a food questionnaire. You are entitled to change your mind at any point during the study and without giving a reason.

What will happen to the data?

All the data collected will be kept confidential, and your child's name will not be used in the final thesis or presentation. The data from this study will be stored securely in case the collected data needs to be reviewed at any point. You will receive a debrief letter after conclusion of the study and if you wish to have a copy of the results you can request the researcher. If you prefer to withdraw from the study you may request your data to be destroyed.

Who has reviewed the study?

The Ethics Department at Bangor University and your son/daughters school have reviewed the study and both agreed that it could be beneficial for the children, families and the school.

Who do I contact with any concerns about this study?

If you have any concerns or complaints about this study, or the conduct of individuals conducting this study, then please contact the researcher xxxxx.In addition, if you have any concerns about any aspect of the study, you may contact Carl Hughes, Supervisor in the Psychology Department of Bangor University. c.hughes@bangor.ac.uk

Appendix C: Parent Consent Form

Comparing simultaneous versus sequential feeding procedures in reducing food selectivity in children with Autism

Parent Consent Form

Name of researcher:

Please initial/sign box

I confirm that I have read and understand the information sheet dated January 2016 for the study. I have had the opportunity to consider the information, ask questions and have these answered satisfactorily.		
I understand that my son/daughters participation is voluntary and that I have the right to remove my son/daughter from the study at any point, without giving any reason, and without my or my son/daughters education or legal rights being affected.		
I understand that my son/daughters food data may be used for the study. I understand that some of the data will be graphed and potentially used in publication. I understand the names used with be pseudonyms and nobody, apart from the researcher and limited staff involved, will be able to identify the pupils involved in the study.		
I understand that any videoing of the sessions will only be used to further analyse data, for additional observations to assess the intervention and for training for staff involved.		
I agree that the data taken from this research will be kept for up to 6 years at Bangor University after the end of this research to compare to other research if needed. I understand that the information will be held securely and marked with a number only.	Yes	No
I would like to receive a summary of the findings at the end of the study.	Yes	No

I agree to allow my son/daughter to take part in the above research.	

Please sign and return this form to the researcher at your earliest convenience.

Parent/Guardian Signature:…… Date……

Name in block letters:……

Address and/or contact number:……..…

If you have any further questions, please contact the supervisor of the project, Dr. Carl Hughes, Brigantia Building, School of Psychology, Bangor University, Gwynedd, LL57 2DG (Tel: 01248 383278: email: c.hughes@bangor.ac.uk), or contact (name of schools contact) (Tel:

If you have any complaints about how this study is conducted please address these to: Mr Hefin Francis, Manager, School of Psychology, Bangor University, LL57 2DG.

Appendix D: School Consent Form

Comparing simultaneous versus sequential feeding procedures in reducing food selectivity in children with Autism

School Consent Form

Name of researcher:

Please initial/sign box

I confirm that I have read and understand the information sheet dated February 2016 for the study. I have had the opportunity to consider the information, ask questions and have these answered satisfactorily.		
I understand that the pupils participation is voluntary and that their parents have the right to remove their child from the study at any point, without giving any reason, and without the pupils education or legal rights being affected.		
I understand that the pupils food data may be used for the study. I understand that some of the data will be graphed and potentially used in publication. I understand the names used with be pseudonyms and nobody, apart from the researcher and limited staff involved, will be able to identify the pupils involved in the study.		
I agree that the data taken from this research will be kept for up to 6 years at Bangor University after the end of this research to compare to other research if needed. I understand that the information will be held securely and marked with a number only.	Yes	No
I would like the school's name to be present on the research.	Yes	No
I would like to receive a summary of the findings at the end of the study.	Yes	No
I agree to allow the above research to take place at this school.		

Please sign and return this form to the researcher at your earliest convenience.

Head teacher Signature:…… Date……

Head Teacher Name in block letters:……

Address and/or contact number:……..…

If you have any further questions, please contact the supervisor of the project, Dr. Carl Hughes, Brigantia Building, School of Psychology, Bangor University, Gwynedd, LL57 2DG (Tel: 01248 383278: email: c.hughes@bangor.ac.uk), or contact (name of schools contact) (Tel:

If you have any complaints about how this study is conducted please address these to: Mr Hefin Francis, Manager, School of Psychology, Bangor University, LL57 2DG.

Appendix E: Operational Definitions of challenging behaviour displayed by Nigel

1. Crying = high pitched elongated sound accompanied by tears
2. Whining = high pitched long sound
3. Screaming = loud high pitched sound
4. Clapping = Flat palms slap together with force
5. Covering ears = Palm of hands cover ears
6. Flopping = Moves body to the floor leaning backwards with pressure onto tutor, chair, floor or lays flat on the floor
7. Hitting others = Flat hand(s) will move towards others and make contact
8. Hitting self = Flat hand(s) will move towards others and make contact
9. Bolting = Moves away from tutor/activity quickly without instruction
10. Pinching = Pincer grasp of fingertip(s) and thumb to grip another person's skin
11. Climbing = Climbs onto furniture using knees or feet
12. Hands down trousers = hand(s) and forearm down the front of pants or trousers
13. Removing clothing = removes items of clothing from his body

Appendix F: Operational Definitions of challenging behaviour displayed by Thomas

1. Face pressing = Flat hands, palm out placed either side of nose and applies pressure
2. Crying = A sob accompanied by tears
3. Hitting = Using flat hand will move towards others and makes contact
4. Kicking = moves feet outwards rapidly making contact
5. Flopping = Moves his body to the floor by first leaning backwards with pressure onto tutor or chair, or may move forward or sideways to floor from a seated position.
6. Biting = may occur if blocked from face pressing. Presses face against another's arm and clenches teeth together
7. Whining = high pitched long sound, sometimes accompanied by saying 'why, why'
8. Throwing objects = picks up objects and projects them away from him
9. Bolting = Will run quickly away
10. Swiping = Using hands will push objects onto surfaces or on to the floor
11. Non-contextual laughing = will laugh in a nervous manner and often it is accompanied or precursive to other topographies.
12. Tipping = using one or both hands will empty the contents of containers
13. Scripting = repeating words or phrases that are not related to the current situation
14. Shaking head = vigorously moves head from side to side repeatedly

Appendix G: Operational Definitions of challenging behaviour displayed by Simon

1. Whining = A continuous dull sound
2. Crying = A sob accompanied by tears
3. Hitting self = Will hit self in the face
4. Head butting = Will hit his own head gently in to another person's head
5. Banging elbows on table = will bang elbows forcibly on to the table
6. Stamping = Brings feet down onto surface forcibly
7. Screaming = A high pitch shriek sometimes accompanied by the word 'no'
8. Shouting = Yells out the word 'No'
9. Removing shoes = Will remove his shoes using the support of own feet
10. Throwing objects = Will pick up objects using hands and will throw them
11. Taking his shoes off = Will remove his shoes mainly using the support of his legs.
12. Turning away = Will turn head and body away from the speaker

Appendix H: Food Preferences Questionnaire

Comparing simultaneous versus sequential feeding procedures in reducing food selectivity in children with Autism

Food Preferences Questionnaire

Dear Parent,

In order to assist me in selecting the foods that I offer to your child during my research study, I would appreciate your input.

1. For each of the foods listed in the five food groups below, could you please indicate those that your child is likely to eat: *often, sometimes* or *never* by selecting the most appropriate box.

2. I would also appreciate your suggestions on the types of food in each of the four food groups, that you would particularly like your child to be offered. If there are any that are not listed, please add them in the spaces provided at the bottom of the table.

3. Practical considerations will prevent me from using any foods that need to be cooked.

Please note that if your child is on a restricted diet, e.g. gluten free (GF) or casein free (CF), then the foods listed refer to the GF/CF versions, e.g. bread/biscuits. Foods which cannot be guaranteed to be GF/CF will not be used. If your child has any additional allergies or intolerances these will also be avoided.

Thank you for your continued cooperation.

Does your child have any allergies or intolerances? Please list below

_____

_____

Please fill out the tables below about food preferences:

Starch	Often Eats	Sometimes Eats	Never Eats	Used to eat, now does not eat	Would like the child to be offered
Brown bread					
White bread					
Pasta					
Rice					
Noodles					
Crackers					
Sugary cereals					
Whole grain cereals					

Protein	Often Eats	Sometimes Eats	Never Eats	Used to eat, now does not eat	Would like the child to be offered
Chicken					
Beef					
Lamb					
Fish					
Eggs					
Sausage					
Nuts					
Seeds					

Vegetable	Often Eats	Sometimes Eats	Never Eats	Used to eat, now does not eat	Would like the child to be offered
Carrots raw					
Carrots cooked					
Cucumber					
Tomatoes					
Broccoli					
Beans					
Peas					
Sweetcorn					
Pepper					

Fruit	Often Eats	Sometimes Eats	Never Eats	Used to eat, now does not eat	Would like the child to be offered
Banana					
Orange					
Grape					
Pear					
Plum					
Peach					
Melon					
Pineapple					
Strawberry					
Raspberry					

Blueberry					
Blackberry					
Raisin					
Dried apricots					

Dairy	Often Eats	Sometimes Eats	Never Eats	Used to eat, now does not eat	Would like the child to be offered
Milk					
Yoghurt					
Cheese					

Please add in this table, any other food that you would particularly like your child to be offered during the study e.g. foods that your child used to eat but has now stopped eating.

STARCH
PROTEINS

VEGETABLES
FRUIT
DAIRY

Appendix I: Preferred food preferences questionnaire

Comparing simultaneous versus sequential feeding procedures in reducing food selectivity in children with Autism

Preferred Food Preferences Questionnaire

Dear Parent,

In order to increase preferences of non-preferred foods, we are going to use your child's most preferred food to do this. We are going to conduct a preference assessment to determine which is your child's MOST preferred food. Please could you list below what you think are your child's 6 most preferred foods, starting with their most highly preferred food at 1.

1. (most preferred) _____

2._____

3. _____

4. _____

5. _____

6. _____

Thank you for your continued cooperation.

Appendix J: Initial Datasheet

Date_____
Pupil_____
Method – sequential / simultaneous (please circle)
Non-preferred food _____
Preferred food _____
Tutor _____
IOA _____

Trials	Criteria 1	Criteria 2	Criteria 3	Comments
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

Criteria 1: The food was swallowed and no traces remained in mouth (i.e. clean mouth)

Criteria 2: Some attempt to consume the food occurred; either food was consumed then expelled, partially consumed, or any other effort to consume that did not meet criteria 1 or 3

Criteria 3: The participant made no attempt to consume the food

Appendix K: Procedural Adaptation Datasheet

Date_____
Pupil_____
Method _____
Non-preferred food _____
Preferred item/food _____
Tutor _____
IOA _____

Trials	Criteria 1	Criteria 2	Criteria 3	Comments
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

Criteria 1: The participant imitated the correct response

Criteria 2: The participant made any attempt to imitate the correct response that did not meet criteria 1 or 3

Criteria 3: The participant made No attempt to imitate the correct response

Appendix L: Social Validity Questionnaire

Comparing simultaneous versus sequential feeding procedures in reducing food selectivity in children with Autism

Social Validity Questionnaire Parents

Many thanks for your help with this study. We would appreciate your feedback once more to help us understand your views on the study. For each question, please circle the number that you feel best represents your views.

---

1. Before the study, my child's acceptance of the targeted foods was:

1 2 3 4 5 6 7

Significantly worse Significantly better

---

2. Following the project, my child's acceptance of the targeted foods was:

1 2 3 4 5 6 7

Significantly worse Significantly better

---

3. How confident are you introducing new foods to your child:

1 2 3 4 5 6 7

Very unconfident Very confident

---

4. I feel that the successful approach reported by the researcher is helping my child's food selectivity is:

1 2 3 4 5 6 7

Not appropriate Very appropriate

---

5. At this point, I feel the participation of the study was:

1 2 3 4 5 6 7

Extremely unhelpful Extremely helpful

Thank you for your assistance.

Appendix M: Standardised training documents

BeyondAutism

Protocol for carrying out SEQUENTIAL food programme

Materials needed:

- Pre-cut preferred food (_____)
- Pre-cut Non-preferred food (_____)
- Timer
- Datasheet

Criteria:

Criteria 1: The food was swallowed and no traces remained in mouth (i.e. clean mouth)

Criteria 2: Some attempt to consume the food occurred; either food was consumed then expelled, partially consumed, or any other effort to consume that did not meet criteria 1 or 3

Criteria 3: The participant made no attempt to consume the food

Protocol:

1. Start timer
2. Present non-preferred food, ensuring preferred food is visible
3. Say 'try the food'
4. Wait 20 seconds
5. If they eat the food within 20 seconds, deliver the preferred food and say 'well done'. Remove the plate/all relevant items. Record the criteria (see above) on the datasheet as appropriate.
6. If they don't eat the food after 20 seconds, remove the non-preferred and preferred food items and record the criteria (see above) on the datasheet as appropriate.
7. Note any problem behaviour or additional comments in the comments section of the datasheet (e.g. gagged, crumbled food, threw food etc).
8. Wait 20 seconds and repeat steps 1 to 7 for 10 trials.

Notes:

- Ensure you have enough food items prepped in case of throwing, crumbling etc.
- Do not use any additional tangible reinforcers.
- Additionally record any ABC's on your ABC datasheet as per usual.

BeyondAutism

Protocol for carrying out SIMULTANEOUS food programme

Materials needed:

- Pre-made sandwiched preferred food (_____) and non-preferred food (_____)
- Timer
- Datasheet

Criteria:

Criteria 1: The food was swallowed and no traces remained in mouth (i.e. clean mouth)

Criteria 2: Some attempt to consume the food occurred; either food was consumed then expelled, partially consumed, or any other effort to consume that did not meet criteria 1 or 3

Criteria 3: The participant made no attempt to consume the food

Protocol:

1. Start timer
2. Present sandwiched preferred food and non-preferred food.
3. Say 'try the food'
4. Wait 20 seconds
5. If they eat the food within 20 seconds say 'well done'. Remove the plate/all relevant items. Record the criteria (see above) on the datasheet as appropriate.
6. If they don't eat the food after 20 seconds, remove the non-preferred and preferred food items and record the criteria (see above) on the datasheet as appropriate.
7. Note any problem behaviour or additional comments in the comments section of the datasheet (e.g. gagged, crumbled food, threw food etc).
8. Wait 20 seconds and repeat steps 1 to 7 for 10 trials.

Notes:

- Ensure you have enough food items prepped in case of throwing, crumbling etc.
- Do not use any additional tangible reinforcers.
- Additionally record any ABC's on your ABC datasheet as per usual.

Protocol for carrying out GRADUATED EXPOSURE food programme

Materials needed:

- Pre-cut Non-preferred food (_____)
- Pre-cut preferred food if applicable (_____)
- Chosen tangible reinforcer (_____)
- Timer
- Datasheet

Criteria:

Criteria 1: The participant imitated the correct response

Criteria 2: The participant made any attempt to imitate the correct response that did not meet criteria 1 or 3

Criteria 3: The participant made No attempt to imitate the correct response

Protocol:

1. Present chosen tangible reinforcer to ensure there is motivation.
2. Remove chosen tangible reinforcer and start timer
3. Present non-preferred food, ensuring chosen tangible reinforcer is visible
4. Say 'copy me' and perform the correct step of the graduated exposure sequence (see below).
5. Wait 20 seconds
6. If they imitate the response within 20 seconds, deliver the chosen tangible reinforcer for 20 seconds (and preferred food if applicable) and say 'well done'. Remove the plate/all relevant items. Record the criteria (see above) on the datasheet as appropriate.
7. If they don't imitate the response after 20 seconds, remove the non-preferred food and chosen tangible reinforcer and record the criteria (see above) on the datasheet as appropriate.
8. Note any problem behaviour or additional comments in the comments section of the datasheet (e.g. gagged, crumbled food, threw food etc).
9. Wait 20 seconds (with or without chosen tangible reinforcer as relevant) and repeat steps 1 to 8 for 10 trials.

Notes:

- Ensure you have enough food items prepped in case of throwing, crumbling etc.
- Do not use any additional tangible reinforcers.
- Additionally record any ABC's on your ABC datasheet as per usual.

Appendix N: Procedural Integrity Checklists

Checklist for identifying Procedural Fidelity of the implementation of the SEQUENTIAL feeding programme

	Date	Comments
Area one: Organisation		
Instructional area is neat and clean		
All materials needed are organised and ready		
Sufficient food items available		
Area two: Procedure		
Timer started		
Food dimensions correct		
Correct sd used		
Preferred food in sight		
Waits 20 seconds or until food eaten		
Correct social praise used if relevant		
Does not provide any additional tangible reinforcement		
Removes food items as appropriate		
Waits 20 seconds between trials		
Runs 10 trials		
Area three: Data Collection		
Records criteria as appropriate		
Records any problem behaviours in the comments box		
Records any problem behaviours on ABC datasheets		
Records additional comments as relevant		

Checklist for identifying Procedural Fidelity of the implementation of the SIMULTANEOUS feeding programme

	Date	Comments
Area one: Organisation		
Instructional area is neat and clean		
All materials needed are organised and ready		
Sufficient food items available		
Area two: Procedure		
Timer started		
Food dimensions correct		
Correct sd used		
Non-preferred food and preferred food presented together		
Waits 20 seconds or until food eaten		
Correct social praise used if relevant		
Does not provide any additional tangible reinforcement		
Removes food items as appropriate		
Waits 20 seconds between trials		
Runs 10 trials		
Area three: Data Collection		
Records criteria as appropriate		
Records any problem behaviours in the comments box		
Records any problem behaviours on ABC datasheets		
Records additional comments as relevant		

Checklist for identifying Procedural Fidelity of the implementation of the GRADUATED EXPOSURE feeding programme

	Date	Comments
Area one: Organisation		
Instructional area is neat and clean		
All materials needed are organised and ready		
Sufficient food items available		
Chosen tangible reinforcer available		
Area two: Procedure		
Timer started		
Correct level of hierarchy targeted		
Correct sd used		
Chosen tangible reinforcer in sight		
Waits 20 seconds or until correct response emitted		
Correct social praise used if relevant		
Does not provide any additional tangible reinforcement		
Removes food items as appropriate		
Waits 20 seconds between trials OR Delivers chosen tangible reinforcer for 20 seconds		
Runs 10 trials		
Area three: Data Collection		
Records criteria as appropriate		
Records any problem behaviours in the comments box		
Records any problem behaviours on ABC datasheets		
Records additional comments as relevant		

Appendix O: Systematic Fading Steps

The following steps were **planned** to fade in the sequential condition:

1. $1cm^2$ NPF followed by two $1cm^2$ PF items.
2. $2cm^2$ NPF followed by two $1cm^2$ PF items.
3. $2cm^2$ NPF followed by two $0.5cm^2$ PF items.
4. $2cm^2$ NPF followed by one $0.5cm^2$ PF item.
5. Two pieces of $2cm^2$ NPF followed by one $0.5cm^2$ PF item.
6. Two pieces of $2cm^2$ NPF, no PF.

The following steps were **planned** to fade in the simultaneous condition:

1. $1cm^2$ NPF sandwiched between two $1cm^2$ PF items.
2. $2cm^2$ NPF sandwiched between two $1cm^2$ PF items.
3. $2cm^2$ NPF sandwiched between two $0.5cm^2$ PF items.
4. $2cm^2$ NPF alongside one $0.5cm^2$ PF item.
5. Two pieces of $2cm^2$ NPF alongside one $0.5cm^2$ PF item.
6. Two pieces of $2cm^2$ NPF, no PF.

The following steps were **used** to fade the ratio of **cucumber** to cheese for **Nigel** in the simultaneous condition:

1. $1cm^2$ NPF sandwiched between two $1cm^2$ PF items.
2. $2cm^2$ NPF sandwiched between two $1cm^2$ PF items.

3. 2cm^2 NPF sandwiched between two 0.5cm^2 PF items.

The following steps were **used** to fade the ratio of **apple** to cheese for **Nigel** in the simultaneous condition:

1. 1cm^2 NPF sandwiched between two 1cm^2 PF items.

2. 2cm^2 NPF sandwiched between two 1cm^2 PF items.

3. 1.5cm^2 NPF sandwiched between two 1cm^2 PF items.

Appendix P: Graduated Exposure Hierarchy:

1. Food on plate
2. Touch food with finger
3. Pick food up
4. Put food to mouth
5. Lick food
6. Place food on tongue
7. Touch teeth together on food
8. Bite food in to two pieces
9. Bite food in to two pieces and swallow one piece
10. Bite food in to two pieces and swallow both pieces

Appendix Q: Debrief form

Comparing simultaneous versus sequential feeding procedures in reducing food selectivity in children with Autism

Debriefing Form

Thank you for agreeing to participate in this research. The general purpose of this research was to assess whether simultaneous presentation or sequential presentation can reduce food selectivity in children with autism.

We invited pupils who are within our school setting and are diagnosed with ASD and food selectivity. In this study, your son/daughter was required to spend 15-20 minutes every day during their lessons. The staff and researcher involved took frequency data to compare results of simultaneous and sequential presentation. This data was assessed to consider whether simultaneous is more effective than sequential reinforcement with regards to food selectivity and food refusal. The results of this study found _____. The findings of this research will help other practioners better choose procedures to help children in similar situations.

Thank you again for your participation in this study. If you have further questions about the study, please contact the researcher xxxxx. In addition, if you have any concerns about any aspect of the study, you may contact Carl Hughes, Supervisor in the Psychology Department of Bangor University. c.hughes@bangor.ac.ukTel: 01248383278

Thank you again for your cooperation!

Yours sincerely

Appendix R: Tables of results

Results as taken from the datasheets and entered into Excel. For the raw datasheets, IOA data or procedural integrity data please contact the author.

Nigel Data:

Session	Phase	Method	Food	Total number of trials	Criteria 1	Criteria 2	Criteria 3	% Bites Consumed	Duration of Challenging Behaviour (seconds)
1	Baseline	Baseline	Apple	5	0	0	5	0	0
2	Baseline	Baseline	Strawberry	5	0	0	5	0	0
3	Baseline	Baseline	Strawberry	5	0	0	5	0	0
4	Baseline	Baseline	Apple	5	0	0	5	0	0
5	Sim vs. Seq	Sequential	Strawberry	10	0	2	8	0	0
6	Sim vs. Seq	Simultaneous	Apple	10	9	0	1	90	0
7	Sim vs. Seq	Simultaneous	Apple	10	10	0	0	100	0
8	Sim vs. Seq	Sequential	Strawberry	10	10	0	0	100	19
9	Sim vs. Seq	Simultaneous	Apple	10	10	0	0	100	0
10	Sim vs. Seq	Sequential	Strawberry	10	0	0	10	0	8
11	Sim vs. Seq	Simultaneous	Apple	10	9	0	0	90	5
12	Sim vs. Seq	Sequential	Strawberry	10	0	0	10	0	33
13	Superior Treatment Phase	simultaneous	Strawberry	10	0	0	10	0	166
14	Superior Treatment Phase	Simultaneous	Apple	10	0	8	2	0	0
15	Superior Treatment Phase	Simultaneous	Apple	10	9	1	0	90	0
16	Superior Treatment	simultaneous	Strawberry	10	0	0	10	0	50

	Phase								
17	Superior Treatment Phase	Simultaneous	Apple	10	9	1	0	90	0
18	Superior Treatment Phase	Simultaneous	Strawberry	10	0	0	10	0	0
19	Demand Fading (2cm NPF, 1cm PF)	Simultaneous	Apple	10	0	10	0	0	6
20	Demand Fading (2cm NPF, 1cm PF)	Simultaneous	Apple	10	4	5	1	40	0
21	Baseline	Baseline	cucumber	5	0	0	5	0	0
22	Demand Fading (2cm NPF, 1cm PF)	Simultaneous	Apple	10	2	8	0	20	0
22	Baseline	Baseline	cucumber	5	0	3	2	0	37
23	Demand Fading (2cm NPF, 1cm PF)	Simultaneous	Apple	10	7	3	0	70	0
24	Superior Treatment Phase	Simultaneous	cucumber	10	9	1	0	90	0
25	Superior Treatment Phase	Simultaneous	cucumber	10	10	0	0	100	0
26	Demand Fading (2cm NPF, 1cm PF)	Simultaneous	Apple	10	6	4	0	60	30
27	Superior Treatment Phase	Simultaneous	cucumber	10	10	0	0	100	0
28	Demand Fading (2cm NPF, 1cm PF)	Simultaneous	cucumber	10	10	0	0	100	0
29	Demand Fading (1.5cm NPF, 1cm	Simultaneous	Apple	10	10	0	0	100	0

	PF)								
30	Demand Fading (2cm NPF, 1cm PF)	Simultaneous	cucumber	10	9	1	0	90	0
31	Demand Fading (1.5cm NPF, 1cm PF)	Simultaneous	apple	10	9	0	1	90	0
32	Demand Fading (2cm NPF, 1cm PF)	Simultaneous	cucumber	10	10	0	0	100	0
33	Demand Fading (1.5cm NPF, 1cm PF)	Simultaneous	Apple	10	0	0	10	0	0
34	Demand Fading (2cm NPF, 0.5cm PF)	Simultaneous	cucumber	10	10	0	0	100	0
35	Demand Fading (1.5cm NPF, 1cm PF)	Simultaneous	apple	10	10	0	0	100	0

Thomas Data:

Session	Phase	Method	Food	Total number of trials	Criteria 1	Criteria 2	Criteria 3	% Correct Response	Duration of Challenging Behaviour (seconds)
1	Baseline	Baseline	Cheese	5	0	0	5	0	0
2	Baseline	Baseline	Grapes	5	0	0	5	0	0
3	Baseline	Baseline	Grapes	5	0	0	5	0	3
4	Baseline	Baseline	Cheese	5	0	0	5	0	0
5	Sim vs. Seq	Simultaneous	Cheese	10	2	0	8	20	0
6	Sim vs. Seq	Sequential	Grapes	10	0	5	5	0	149

7	Sim vs. Seq	Simultaneous	Cheese	10	3	4	3	30	149
8	Sim vs. Seq	Sequential	Grapes	10	0	0	10	0	142
9	Sim vs. Seq	Simultaneous	Cheese	5	0	2	3	0	454
10	Sim vs. Seq	Sequential	Grapes	1	0	0	1	0	2340
11	Graduated Exposure Hierarchy	Touch cheese to tongue	Cheese	10	10	0	0	100	8
12	Graduated Exposure Hierarchy	touch grape to tongue	Grapes	10	10	0	0	100	28
13	Graduated Exposure Hierarchy	Touch cheese to tongue	Cheese	10	10	0	0	100	10
14	Graduated Exposure Hierarchy	touch grape to tongue	Grapes	10	10	0	0	100	0
15	Graduated Exposure Hierarchy	Touch cheese to tongue	cheese	10	10	0	0	100	1
16	Graduated Exposure Hierarchy	touch grape to tongue	Grapes	10	10	0	0	100	0
17	Graduated Exposure Hierarchy	put cheese on tongue	cheese	10	9	1	0	90	33
18	Graduated Exposure Hierarchy	put grape on tongue	Grapes	10	9	1	0	90	8
19	Graduated Exposure Hierarchy	put cheese on tongue	Cheese	10	10	0	0	100	0
20	Graduated Exposure Hierarchy	put cheese on tongue	Cheese	10	10	0	0	100	2
21	Graduated Exposure Hierarchy	put grape on tongue	Grapes	10	9	1	0	90	42
22	Graduated Exposure Hierarchy	put grape on tongue	grapes	10	10	0	0	100	5
23	Graduated Exposure Hierarchy	put grape on tongue	Grapes	10	10	0	0	100	0

24	Graduated Exposure Hierarchy	touch teeth together cheese	cheese	10	10	0	0	100	16
25	Graduated Exposure Hierarchy	touch teeth together cheese	Cheese	10	10	0	0	100	2
26	Graduated Exposure Hierarchy	touch teeth together grape	Grapes	10	10	0	0	100	0
27	Graduated Exposure Hierarchy	touch teeth together grapes	Grapes	10	10	0	0	100	0
28	Graduated Exposure Hierarchy	touch teeth together cheese	Cheese	10	10	0	0	100	0
29	Graduated Exposure Hierarchy	touch teeth together cheese	cheese	10	10	0	0	100	0
30	Graduated Exposure Hierarchy	bite grape in half	Grapes	10	0	10	0	0	631
31	Graduated Exposure Hierarchy	bite cheese in half	Cheese	10	9	1	0	90	9
32	Graduated Exposure Hierarchy	bite grape in half	Grapes	10	0	10	0	0	381
33	Graduated Exposure Hierarchy	bite cheese in half	Cheese	10	9	1	0	90	12
34	Graduated Exposure Hierarchy	bite grape in half	Grapes	10	0	10	0	0	164
35	Graduated Exposure Hierarchy	bite cheese in half	cheese	10	10	0	0	100	0
36	Graduated Exposure Hierarchy	bite grape in half	Grapes	10	0	9	1	0	38
37	Graduated Exposure Hierarchy	bite cheese in half and swallow half	cheese	10	1	4	5	10	785

Simon Data:

Session	Phase	Method	Food	Total number of trials	Criteria 1	Criteria 2	Criteria 3	% Correct Response	Duration of Challenging Behaviour (seconds)
1	Baseline	Baseline	Cucumber	5	0	1	4	0	6
2	Baseline	Baseline	Carrot	5	0	0	5	0	9
3	Baseline	Baseline	Carrot	5	0	0	5	0	19
4	Baseline	Baseline	Cucumber	5	0	0	5	0	0
5	Sim vs. Seq	Simultaneous	Carrot	10	0	0	10	0	40
6	Sim vs. Seq	Sequential	Cucumber	10	0	0	10	0	72
7	Sim vs. Seq	Simultaneous	Carrot	10	0	0	10	0	50
8	Sim vs. Seq	Sequential	Cucumber	10	0	0	10	0	14
9	Sim vs. Seq	Simultaneous	Carrot	10	0	0	10	0	242
10	Sim vs. Seq	Sequential	Cucumber	10	0	0	10	0	64
11	Graduated Exposure Hierarchy	Touch cucumber to tongue	Cucumber	10	9	0	1	90	2
12	Graduated Exposure Hierarchy	Put carrot to mouth	carrot	10	10	0	0	100	0
13	Graduated Exposure Hierarchy	Put carrot to mouth	carrot	10	10			100	0
14	Graduated Exposure Hierarchy	Touch cucumber to tongue	Cucumber	10	10	0	0	100	0
15	Graduated Exposure Hierarchy	Touch cucumber to tongue	Cucumber	10	10	0	0	100	0
16	Graduated Exposure Hierarchy	Put carrot to mouth	Carrot	10	10	0	0	100	0

17	Graduated Exposure Hierarchy	Touch carrot to tongue	carrot	10	10	0	0	100	0
18	Graduated Exposure Hierarchy	cucumber on tongue	cucumber	10	6	4	0	60	10
19	Graduated Exposure Hierarchy	cucumber on tongue	Cucumber	10	10	0	0	100	0
20	Graduated Exposure Hierarchy	Touch carrot to tongue	Carrot	10	10	0	0	100	0
21	Graduated Exposure Hierarchy	cucumber on tongue	Cucumber	10	10	0	0	100	3
22	Graduated Exposure Hierarchy	Touch carrot to tongue	carrot	10	10	0	0	100	0
23	Graduated Exposure Hierarchy	cucumber on tongue	Cucumber	10	10	0	0	100	3
24	Graduated Exposure Hierarchy	carrot on tongue	carrot	10	10	0	0	100	0
25	Graduated Exposure Hierarchy	touch teeth together cucumber	cucumber	10	10	0	0	100	0
26	Graduated Exposure Hierarchy	touch teeth together cucumber	Cucumber	10	10	0	0	100	0
27	Graduated Exposure Hierarchy	carrot on tongue	Carrot	10	10	0	0	100	0
28	Graduated Exposure Hierarchy	touch teeth together cucumber	Cucumber	10	10	0	0	100	0
29	Graduated Exposure Hierarchy	carrot on tongue	carrot	10	10	0	0	100	0
30	Graduated Exposure Hierarchy	touch teeth together carrot	carrot	10	10	0	0	100	0
31	Graduated Exposure Hierarchy	bite cucumber in half	Cucumber	10	3	0	7	30	93

32	Graduated Exposure Hierarchy	touch teeth together carrot	carrot	10	10	0	0	100	0
33	Graduated Exposure Hierarchy	bite cucumber in half	Cucumber	10	0	0	10	0	35
34	Graduated Exposure Hierarchy	touch teeth together carrot	carrot	10	10	0	0	100	0
35	Graduated Exposure Hierarchy	bite cucumber in half	Cucumber	10	0	0	10	0	17
36	Graduated Exposure Hierarchy	bite carrot in half	carrot	10	8	1	1	80	2